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"Arc Welding a Huge Steel Press"—Taken in the shop of Clearing Machine Corp., Clearing, Ill.—Photo obtained through the courtesy of Harnischfeger Corp., Milwaukee, Wis.

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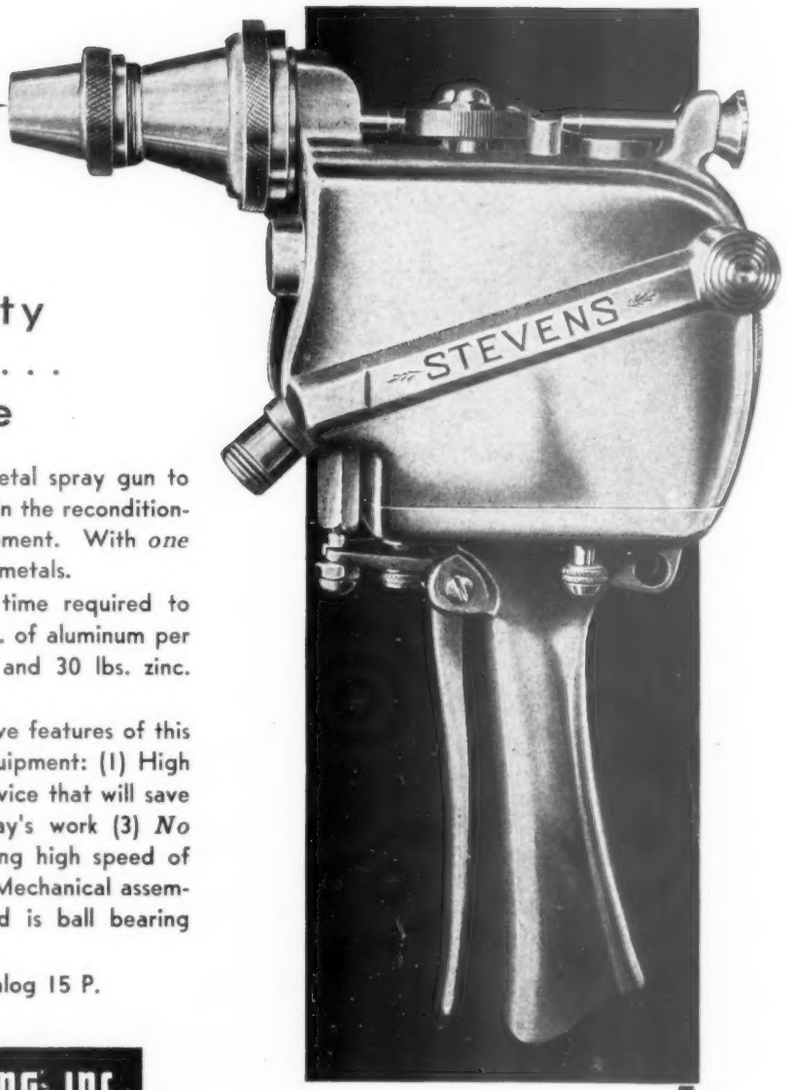

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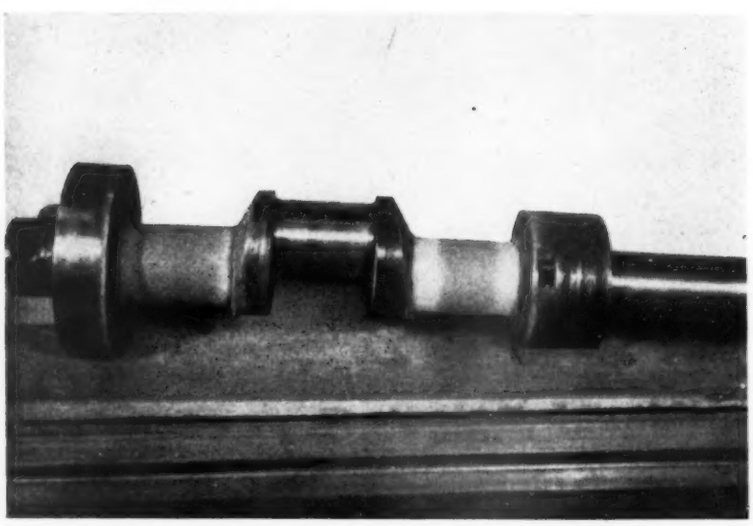


It took just 4 hours and 15 minutes with a Stevens model OZ-3 metal spray gun to repair two main bearings of compression crank shaft. High carbon steel was first sprayed on, then bearings were ground to size and shaft installed.

Limiting the Human Element

TECHNICAL ADVANCEMENT in welding procedure is definitely headed in the direction of less reliance on operational skill. With better welding rods and electrodes and recent improvements in steadier power supply to the welding arc, the degree of manual skill required of operators is considerably less than was required formerly. Our attention was called recently to a rather novel experience. A group of welders passed an insurance qualification test with 100 per cent batting average. The most interesting thing about this test is that three of these men had not had over 100 hours of actual welding experience before taking the qualification test. It is claimed that improvement in arc stability, together with recently developed shielded arc electrodes, made this performance possible.

Heavier currents and larger electrodes help to speed production and cut welding costs. Development of machine welding processes works in the same direction. The need for cutting welding costs is evident from a study of E. W. P. Smith's paper on pages 28-31 of this issue. The trend in resistance welding is very definitely toward complete elimination of the human element. The machines are made about as fool-proof as possible so that very little manipulative skill is required. The operator's job is analogous to that of feeding a press.

★

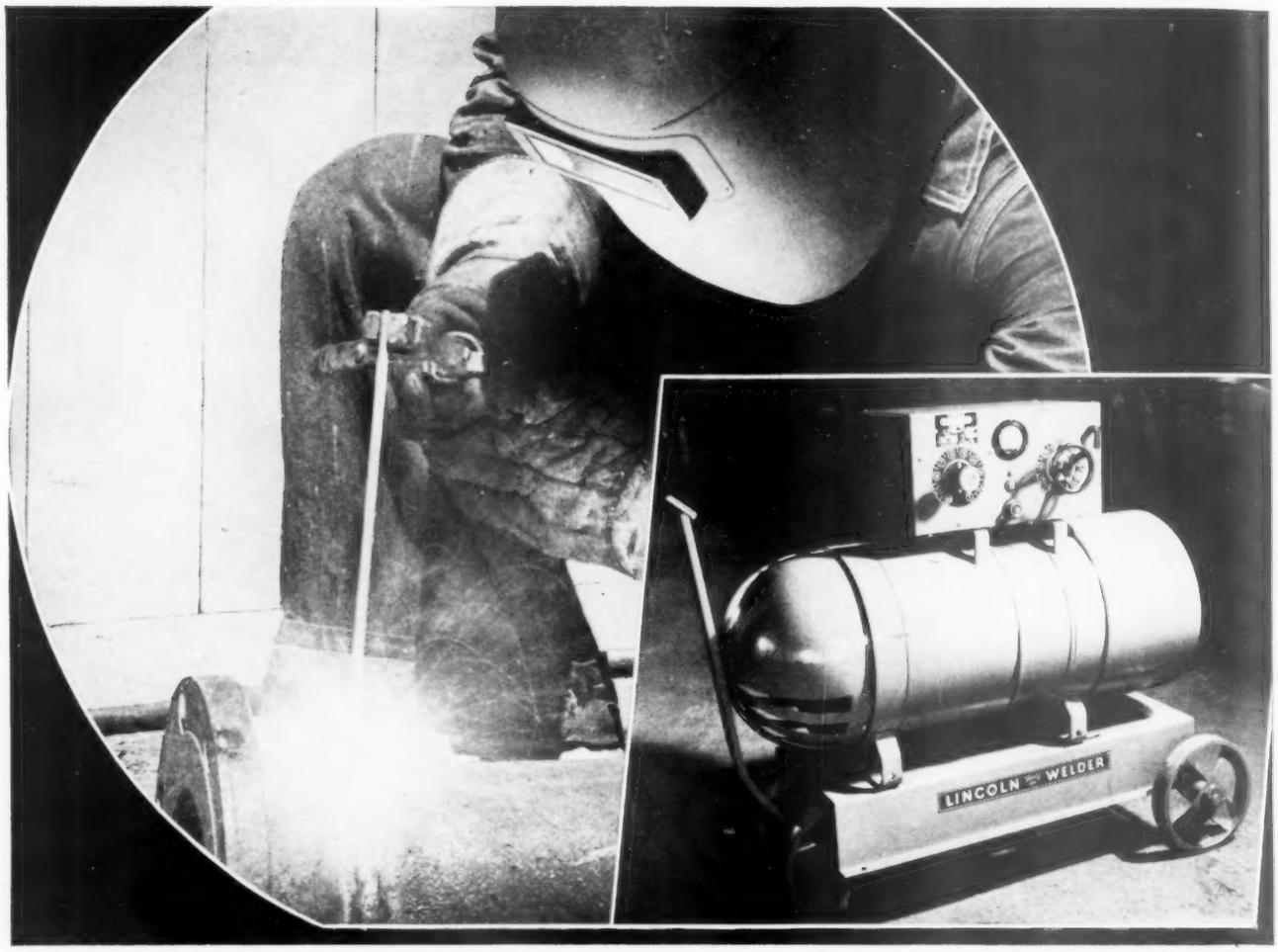
Wanted—More Jobs for Welders

IT IS EVIDENT TO ALL OF US that there are many welders out of work. We realize, of course, that not only welders are looking for work, but men of practically every other trade and profession. The present need for jobs is so acute that everyone in industry should help to change the attitude of mind of the public. We feel reasonably certain that the present recession is not the result of a "capital strike" as some people seem to think. There is, however, too much of a "defeatist" psychology which is gumming up the works. We need to discard the idea quickly that business can get nowhere so long as the present New Deal administration rules in Washington. There is business to be had if enough important people make up their minds to get to work and make the most out of the present situation. Aggressive industrial leaders can and will forge ahead while their weaker brothers continue to "sing the blues."

We have evidence of this enlightened spirit in the case of two important organizations. Aluminum Company of America has announced plans to keep up its production of aluminum ingot, despite the falling off of demand for finished products. Despite reduction of more than 60 per cent in orders during recent months, this company has not curtailed its ingot production. During the lean years following 1929 the Aluminum Company pursued the same policy until it had accumulated an enormous inventory. Beneficial effect of this policy is a steadying influence on employment in the communities where the plants are located.

Manning, Maxwell & Moore, Inc., a manufacturer of valves, gauges, safety valves and control instruments announces an increase in general sales force of 25 per cent at a time when other companies are reducing sales forces. According to the sales manager, "our enlarged sales force will enable us to call on more new prospects and our present ones more frequently." In other words, smaller territories and more complete coverage.

It is well known that business forecasting is a hazardous job for anyone to attempt. However, within the last few weeks we have heard from a few men, well qualified in their knowledge of economics, who take an optimistic point of view and actually predict substantial improvement in business activity within the next few months. In doing so, these gentlemen pointed out that business had not gone on a "spree." There were no signs of "over production" or "over expansion" of manufacturing facilities. Probably the only weak spot had been a little too much time payment financing of certain types of consumer goods, notably automobiles. This will require an interval of several months to permit consumer buying power to catch up with committments. Manufacturing and trade inventories are not excessive. We are told there is an abundant supply of cheap money available if anyone deserving of credit desires to borrow money. On top of it all there is very evident a real need for certain durable goods, such as small homes for families of modest means, household appliances and labor-saving devices of all types. Industry, in view of rising costs and taxes, needs more efficient productive tools to lower its costs.



Here, "SHIELD-ARC SAE" CUTS WELDING COSTS 25% TO 66%

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Large agitation tank of columbium-bearing 18-8 chromium-nickel steel being gas welded with columbium - bearing stainless steel rod.

Practical suggestions helpful in welding of

Low-Alloy and Stainless

★ Digests of several recent technical papers furnish much valuable data on weldability and correct procedure control for arc, oxy-acetylene and resistance processes

ALLOY STEELS are generally low carbon steels to which have been added certain alloys in order to produce the physical properties which the designer requires. This group of steels have yield strengths around 60,000 psi. and ultimate strengths of 90,000 psi. or higher. Many of these low alloy steels have greater resistance to corrosion and abrasion than ordinary steels. At the present time low alloy steels cost approximately double the cost of low carbon steel, hence low alloy metal is used to best advantage to withstand tension, bending, fatigue and impact.

The demand of industry for materials to withstand excessive heat and corrosion has led to the perfection of stainless steels. Their degree of resistance to heat and corrosion depends upon the amount of alloying elements present. The simplest of these stainless steels contains about 12 per cent chromium. Other varieties contain chromium in increasing amounts, but most of these alloys consist of 18 per cent chromium and 8 per cent or more of nickel.

Stainless steels are highly resistant to most acids, the exceptions being sulphuric and hydrochloric. They can resist oxidation and scaling at high temperature and retain their strength and toughness under heat. Stainless steels are being used on an increasing scale in the chemical, oil, dairy, food and other industries which need a fabricating material possessing unusual corrosion and heat resistance.

In view of their increasing use, the subject of weldability of low alloy and stainless steels is important. Recent technical papers presented before the American Welding Society and International Acetylene Association have detailed the proper welding procedure necessary in fabricating these steels. Some of the low alloy steels have air hardening properties, necessitating some type of heat treatment to remove brittleness. It seems to be agreed that where the carbon content is below .15 per cent the welds are strong and tough in the as-welded condition.

DR. A. B. KINZEL*

In the symposium on low alloy steels at the last annual meeting of the American Welding Society, Dr. A. B. Kinzel introduced the subject outlining in a general way some of the important factors affecting weld quality. He mentioned air hardening adjacent to the weld zone and stressed the point that this did not necessarily mean a sacrifice of ductility or toughness. Continuing, Dr. Kinzel emphasized that today welding rod and electrodes are available for use by qualified welders which permit making satisfactory welds in low alloy materials. In gen-

*Chief Metallurgist, Union Carbide & Carbon Research Laboratores, New York City.

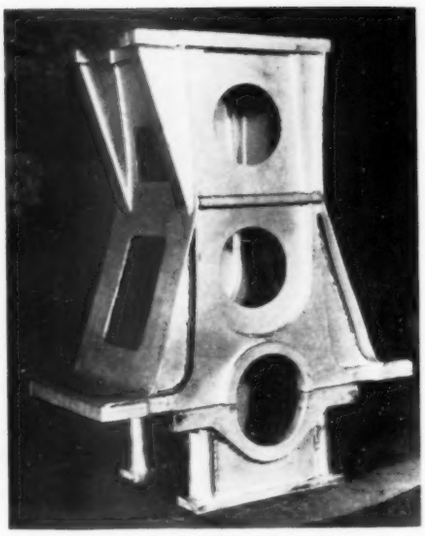
eral, internal stresses are less troublesome on account of the use of lighter material. The following is taken from Dr. Kinzel's paper:

High Ductility

Welded joints must be tough. Toughness used in this sense involves chiefly ductility under static and dynamic conditions, and applies to all portions of the joint, be the zone in question ever so narrow. One type of zone which may be produced in the welding of low-alloy steels and which may not have the requisite toughness is that zone adjacent to the weld which has been subjected to rapid cooling from above the transformation temperature of the steel. The nature of this zone is a function of the air hardening properties of the steel, and as a result there has been a strong tendency for the uninitiated to use hardness as a criterion of the properties of this zone. This involves the assumption that hardness and lack of toughness are synonymous.

Such an assumption is tenable when discussing plain carbon steels, and it is even tenable when discussing very large changes in hardness of low-alloy steels. But the whole purpose of alloying structural steels is to obtain greater strength or hardness without sacrificing ductility or toughness. Thus, extra care should be taken when considering low-alloy steels not to confuse the issue on this score.

Process equipment of stainless clad steel, such as this welded vessel for chemical use, is made of parts cut to exact shape by oxy-acetylene flame.



Experimental single-cylinder diesel engine frame is fabricated of low-alloy, high tensile steel.

The second problem in the application of low-alloy steels involves strength, that is, the joint must be as strong as the base metal. Assuming toughness, this really is no problem at all if we consider only the tensile strength ranges in vogue today. The annealing effect on welding low-alloy steels is small enough, so that decrease in strength on this score is of no moment, and both gas and electric welding rods have been developed which adequately meet the requirements for the deposited metal.

Mechanical Soundness

Another problem involves dependability of the joint, and this reduces to simple mechanical soundness. This problem is solved by good engineering. Well-designed joints made with previously tested welding rod or electrode known to have satisfactory welding characteristics under a wide range of conditions are readily made by qualified welders. The alloy content of the low-alloy steels offered to the trade today is low enough and of such a character as to introduce no problems from the standpoint of fluidity and slag control.

The next problem involved is the uniformity to be expected in welding materials of varying thickness and under varying conditions of design. At the present time this problem is well in hand from the welding standpoint, although many of the low-alloy steels offered to the trade are available only in sheet and plate of relatively small thickness. This seems to be a manufacturing and commercial problem rather than a welding problem.

The last problem concerns the toughness of the structure as a whole, as distinct from toughness of the joint proper. This may be restated as the question of internal stresses. Because low-alloy steels have higher strength than ordinary steel, because this higher strength involves higher yield strength not only at room temperature, but at moderately elevated temperatures, and because the low-alloy steels are used in structures in which rigidity is obtained by selective distribution of material rather than by mere mass, the problem of internal stresses is more acute and must be given more serious consideration with the low-alloy steels of a given section than with the carbon steels.

Lighter Sections

It is not my purpose to enter into this controversial subject, except to point out that the higher the strength, the lighter the material for a given stress and the less chance for trouble from internal stresses. Thus, the mild disadvantages of low-alloy steels cited above are offset by this major advantage.

The welding of low-alloy steels today is an accepted practice. A great variety of steels are available, any one of which is suitable for welded construction. Those steels in which the carbon is kept below .15% and the ultimate strength below 80,000 psi. are classified as foolproof, in that when used in light gage all of the problems above mentioned are adequately met. Those steels having higher carbon content and an ultimate strength not in excess of 95,000 psi., as well as the lower carbon steels in heavier gage, likewise may be used with complete satisfaction with respect to the above mentioned phases provided stress relieving is applied.

Similar Technique

Briefly then, with low-alloy steels, apply intelligent welding practice and follow the same principles as in the welding of carbon steel. Apply similar standards and tests as a measure of the results. It should be realized that after all, the welding of low-alloy steels is a very small step beyond the welding of plain carbon steels and that welding can, therefore, be adapted to such steels in the same manner and in the same degree.

G. S. MIKHALAPOV*

Spot welding of low-alloy steels was fully covered in a paper presented by G. S. Mikhalapov at the last annual meeting of the American Welding Society. Pointing out the higher electrical resistance and lower thermal conductivity of alloy steels, the author emphasized the importance of strict adherence to correct spot welding procedure. His research work has been centered largely on an investigation of the temperature gradient within the weld zone. Improper control of the several variables may result in formation of gas pockets and inferior welds. The author advanced a new slant on the function of welding pressure in spot welding. He contended that the pressure is necessary to raise the boiling point of the metal and prevent its vaporization at that point in the weld zone where temperature increase is a maximum. A longer welding time (8 to 10 cycles) is required with low alloys, but because of higher electrical resistance they require 30 to 50 per cent less current. Another important factor to remember is the greater stiffness of low alloy steels. This may cause spot welds to be stressed beyond the design stress in the base material.

The following is taken from Mr. Mikhalapov's technical paper:

Stricter Control Needed

The rules for good welding of low-alloy steels are in no way different from those for mild carbon steel. There is, however, this difference between spot-welding mild carbon steel and alloy steels. Mild carbon steel is one of the most forbearing of materials. One can commit every sin of spot-welding and still get some kind of a weld. Alloy steels, however, by virtue of their comparatively high electrical resistance and low thermal conductivity, are much more sensitive and require a much stricter adherence to welding rules if satisfactory results are to be obtained.

Generally speaking, spot-welding is the joining of metal sheets or sections by means of a series of localized points of fusion. It usually denotes a joint or bond of one or more sheets or sections, obtained by means of a localized point of fusion, produced by the effect of heat generated by the passage of electric current through the point to be joined. The current is properly controlled to prevent undue vaporization and loss of metal caused by the explosion effect usually accompanying sudden formation of gas. A spot-weld is dependent on two factors—generation of heat at the point of welding and subsequent control of this heat.

*Heintz Mfg. Co., Philadelphia, Pa.

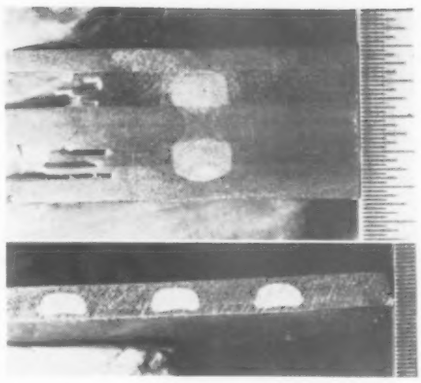


FIG. 1—Comparatively low pressure, low current spot weld through combination of light and heavy guages —Center of fusion at points of maximum resistance and not at the point furthest away from the cooling electrodes.

FIG. 2—High pressure, high current spot weld through light and heavy gauges—Fusion center at point furthest away from cooling electrodes and not at point of maximum resistance or maximum heat generation at junction of the two gauges.

Rate of Heating

It is common knowledge that the passage of electric current through any substance will generate heat, the amount of which will be proportional to the product of the square of the current and electric resistance of the material. Consequently, all that is necessary, to satisfy the first requirement, is the flow of electric current through the point at which a spot-weld is desired, of such magnitude that the rate of heat generation is faster than its dissipation.

Suppose we analyze what happens when heat begins to be generated in a spot-weld. There will be a gradual and definite rise of temperature throughout the mass of metal lying within the path of the welding current. This temperature rise, however, will not be uniform, but will be a function of the distance to the nearest electrode and also of the distance to the joint of the surfaces being welded. Two things enter into this relationship —the rate of generation of heat and the rate of its loss through the highly conductive and comparatively low temperature electrodes. Heat generation is at its maximum at the junction between the surfaces being welded and heat dissipation is directly proportional to the distance from the nearest electrode.

The relative importance of these two factors depends on the welding time used, the shorter the time the more important the surface contact, as the contact resistance decreases rapidly as soon as some fusion occurs. We have a certain mass of metal increasing in temperature at a comparatively high rate in its center (junction of two metals) and at a gradually declining rate as the surface is approached. As the temperature increases, the metal will eventually become liquid. Any subsequent increase in temperature will tend to transform the liquid metal into a gaseous state, and then increase the internal pressure of the gas until it becomes sufficient to separate the surfaces and allow all or part of the gas to escape.

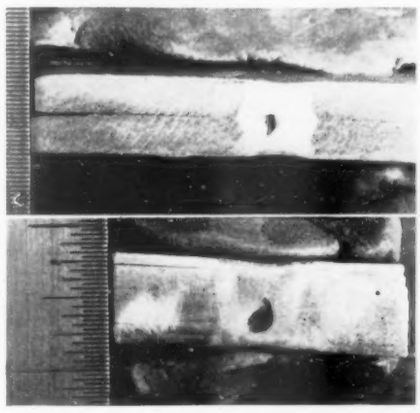
Gas Pockets

In doing this the escaping gas may carry with it, out of the weld zone, a good deal of the surrounding metal which is still in liquid or semi-liquid state. If the weld is now allowed to cool, either the remaining high-pressure gas will, on contracting, form a cavity, or, if the magnitude of the explosion is such that most of the gas and liquid escapes, no weld will result. It is important to note that the factors tending to produce gas and increase the internal pressure will depend on the depth of desired penetration of fusion and the difference in the rate of increase of temperature throughout the weld.

Depth of fusion is fixed by the strength requirements of the weld and

FIG. 3—Inadequate pressure spot weld through two heavy gauges, showing formation of gas pocket.

FIG. 4—Insufficient pressure spot weld through a series of light gauges, showing formation of large gas pocket.



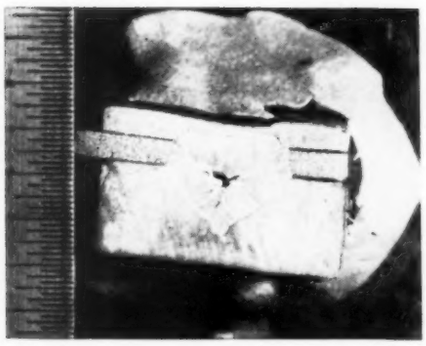


FIG. 5—An extremely large spot weld on two medium and one very heavy guage—shows large shrinkage crack normal to dendritic structure.

is very nearly a constant for any given combination of sheets or sections. The rate of temperature rise, however, is a variable and is essentially a function of surface resistance and thermal conductivity. The higher the surface resistance, the greater will be the difference in the rates of heat generation at the junction of the surfaces being welded and in the metal itself (a steeper temperature gradient). The lower the heat conductivity of the metal, the greater the difference between the heat loss at each welding electrode and at the center of the weld.

Insofar as all alloy steels have considerably lower heat conductivity than mild carbon steel, it is to be expected that the tendency to form high-pressure gas pockets will be more pronounced in low-alloy steels. This is definitely the case and unless the heat generated is carefully controlled and this tendency is properly checked very poor and porous welds will result.

Function of Pressure

Let us now consider the control of the effects of the heat inside the spot-weld. As we have already seen, the difference in the rate of increase of temperature within the weld tends to produce a high-pressure gas pocket in the center of the weld, before the outlying metal has had a chance to melt. There are two obvious ways to deal with this problem. We can cease any further generation of heat as soon as the temperature at the hottest point exceeds the vaporization temperature of the material. Unfortunately, the temperature gradient is sufficiently steep to make the volume of metal at fusion temperature so small that if the weld is allowed to cool a very small and weak bond will result, except, perhaps with very thin sheets.

A better method is to inhibit the vaporization of the metal in the center of the weld by preventing the expansion requisite for transformation of a liquid into a gas. This is usually accomplished by applying an outside force to the parts welded sufficient to prevent any opening of the surfaces and any deformation of the original shape of the parts joined. As a result the expansion accompanying any gas formation is inhibited and the vaporizing temperature of the metal is raised sufficiently to allow the metal at a required distance from the center of the weld to reach melting temperature, thus forming a pool of liquid metal of desired magnitude, but without any gas inclusions.

Contrary to the popular conception the welding pressure does not squeeze

FIG. 6—Extreme case of metal expelled and cavity compressed by continued pressure and excessive heat—Further heat generation would have resulted in a "burned" hole.

FIG. 7—An almost perfect, short time, high current, high pressure, spot weld—Notice uniformity of fusion and heat generation.

the molten or plastic metal together, but, by preventing expansion, it raises the vaporizing temperature of the metal and thus allows the formation of a welded bond of sufficient magnitude.

Because of lower heat conductivity, alloy steel spot-welds have much steeper temperature gradients than mild steel spot-welds. They will, in general, require higher pressures than mild steel spot-welds, and any departure from the correct values will result in the formation of much poorer welds than in mild carbon steel. Experience shows that this is correct and that low-alloy steels require from 50 to 100 per cent higher welding pressures, depending on the thickness welded.

Any increase in the surface resistance of the metal, by increasing the amount of heat generated at the junc-

ture of the surfaces being welded, increases the unevenness of temperature in the weld. In alloy steels it becomes doubly important to reduce this resistance as much as possible. Presence of grease, dirt or scale may aggravate the condition to the extent where considerably increased pressure will not prevent formation of gas pockets and blow-holes. All scale should be carefully removed, as its resistance appears to be greater than that of mild steel.

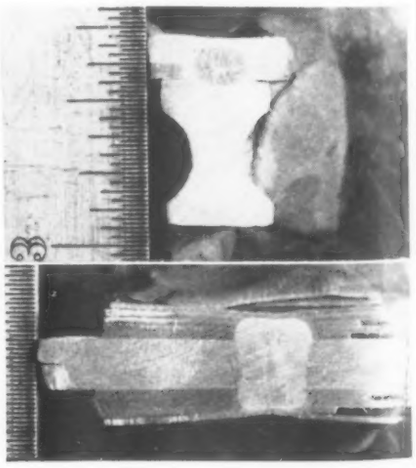
Pressures used in welding mild carbon steels are comparatively low. Except for heavy gages, a pressure of but a few hundred pounds is usually sufficient. This means that in thin sheets the rate of temperature increase is nearly uniform throughout the weld. The present tendency in the spot-welding of mild steel is toward shorter welding periods. As these have reached the short period of but a few cycles of current, the pressure has to be increased somewhat, but in no case to a degree where any appreciable inconvenience to design or operation is experienced.

Welding Time

Consequently the attitude usually found among the welders of mild steel is that the shorter the welding period the better. The shorter the welding time the greater the number of spots per minute and, consequently, the greater the speed of welding. In the

FIG. 8—A spot weld between sheet metal and rolled section showing proper localization of heat at the surface junction.

FIG. 9—High pressure spot weld through a combination of light and heavy gauges with comparatively uniform fusion—Center of weld at point furthest away from cooling electrodes and its location but little influenced by the points of maximum resistance.



case of alloy steels, however, an excessive shortening of time may require pressure of inconveniently high magnitude. For this reason the welding periods used are usually of medium length, 8 to 10 cycles being about the limit.

Less Welding Current

Attention has been drawn to the difficulties encountered in spot-welding low-alloy steels. However, they possess one definite advantage over mild carbon steel and that is, everything else being equal, they require less welding current and, therefore, less welding capacity. The comparatively low thermal conductivity and high electrical resistance, permit the same generation of heat with less current, because the actual heat produced by the passage of a given current through the steel is higher and because the losses through the absorption of heat by the metal surrounding the weld are lower. In general it can be said that the current requirements for spot-welding low-alloy steels are 30 to 50 per cent lower than for mild carbon steel.

Theoretically the only difference between the low-alloy and mild carbon steels, so far as stress analysis and structural design are concerned, is the higher ultimate and yield points of the low alloys. Fundamentally this is true, but one aspect of the higher yield point is the stressing of spot-welds considerably over and above the increase, based on higher design stresses.

For instance, supposing a structure is designed to be built of low-alloy steel with stressed 40 per cent higher than if mild steel were used. We would expect then that the stresses on the spot-welded joints would be 40 per cent higher and that if the total strength of spot-welds used were made 40 per cent greater, all would be well.

Basically this assumption is correct. However, individual spot-welds may be stressed considerably higher and in addition still higher stress concentration may occur at different parts of each spot-weld. This is due to the greater stiffness of the low-alloy steels and sections, which makes more difficult the uniformity of load distribution between the spot-welds and also makes for points of concentrated stress on the areas of individual welds.

A good illustration can be obtained by considering first two sheets of rubber and then two of glass fastened together at point intervals by some means approximating spot-welds. If an attempt is then made to pull the two sheets apart it becomes apparent that, no matter at what angle or direction the load is applied to the rubber sheets, it will be distributed uniformly between the points of fastening. In addition, irrespective of the direction of load the points of fastening will be always in the same kind of stress. In the case of the two sheets of glass, however, the angle and point of application of the load will determine the magnitude and type of stress on each point of fastening.

This does not mean that the low-alloy steels are less suited for spot-welded design than mild carbon steel, but that a different design technique must be followed. It also means that the strength of spot-welds must be more accurately known and controlled. In other words, spot-welding in alloy steel structures must cease to be a hap-hazard hit-or-miss proposition and become an exact science.

(*The second installment of this article will be devoted to stainless steel welding.*)

Fifth Edition of Arc Welding Handbook

"Procedure Handbook of Arc Welding Design and Practice," fifth edition just announced by The Lincoln Electric Co., Cleveland, Ohio, contains 1,012 pages and a total of 1,243 illustrations including photographs and drawings. The handbook is reissued each year to include all new data essential for most efficient use of arc welding in all its varied applications.

The fifth edition, concisely written and profusely illustrated, is a complete arc welding reference guide. Written especially for use of designers, engineers, architects, production managers, welding supervisors and operators, the handbook contains a wealth of data of interest to draftsmen, steel fabricators and erectors, foremen, cost estimators, maintenance managers, shipbuilders, piping and pipe line contractors and students of welding.

To help our readers understand the scope of the new book, we publish below the main subject headings:

Part 1—Welding Methods and Equipment. (24 pages—12 ill.)

Part 2—Technique of Welding. (85 pages—96 ill.)

Part 3—Procedures, Speeds and Costs for Welding Mild Steel. (81 pages—93 ill.)

Part 4—Structure and Properties of Weld Metal. (14 pages—22 ill.)

Part 5—Weldability of Metals. (93 pages—41 ill.)

Part 6—Designing for Arc Welded Steel Construction of Machinery. (154 pages—232 ill.)

Important new machine design data includes: new examples showing how machine parts designs are built from standard rolled steel shapes; design studies of machine parts and complete assemblies; case studies of changeover to welded design; illustrated examples of 140 welded designs, both small and large, for a wide variety of applications; studies of design development of three actual machines.

Part 7—Desigining for Arc Welded Structures. (215 pages—28 ill.)

Important new structural design data includes: new calculations based on up-to-date sizes of mill shapes and on accepted strength value of shielded arc weld metal; additional data on design of welded girders and welding of thin plates to thick plates; six new studies in the design of the trusses of various sizes and applications; profusely illustrated discussion of the new type of beam construction; new information on costs relative to fabricating shop practice.

Part 8—Typical Applications of Arc Welding in Manufacturing, Construction and Maintenance. (289 pages—466 ill.)

The Procedure Handbook is 5-3/4 in. x 9 in. The binding is brown, semi-flexible, simulated leather, gold embossed. Copies will be mailed, post paid, to any address in the United States for $1.50 per copy; foreign $2.00 per copy. The publisher of the Procedure Handbook is The Lincoln Electric Co., Cleveland, Ohio.

Movie Depicts Control of Liquids and Gases

How valves and fittings give us control over liquids and gases is revealed in a sound motion picture entitled "Flow," just released by Crane Co., Chicago. Scenes of rivers in flood, waterfalls and primitive means of controlling flow are followed in the picture by an educational tour through the Chicago works of Crane Co., where the various steps in manufacturing are revealed. Constant testing and research activities emphasize the maintenance of high quality standards in this industry.

Study of economic factors in

Welding Design and Procedure

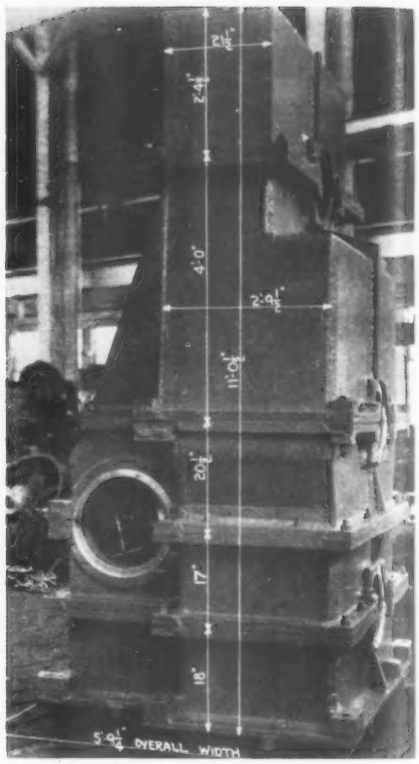
★ Design engineer must consider character of load as well as magnitude—Welding costs compared for different sizes of electrodes.

By E. W. P. SMITH*

Consulting Engineer, Lincoln Electric Co., Cleveland, Ohio

THE PRIME PURPOSE of the application of welding to the fabrication of any product is to reduce the cost thereof. Cost, and therefore cost reduction involves really two items. The first of these is what we term the first cost and the second of these is the service life or the performance of the machine or equipment. If, for the same length or duration of time during which satisfactory performance exists, the first cost can be reduced, then there is a cost reduction. Or if satisfactory performance time can be increased for the same first cost, then there is also a cost reduction. In other words, cost reduction is measured in the service life and the cost for that service life, giving a cost for a unit of service life. If the cost of this unit of service is reduced then the entire cost of the product is reduced. It is of course, very evident that the first item, that is the direct reduction of the first cost is the one most usually demonstrated but performance must not be lost sight of.

The performance or service requirements involve the design and the design involves cost. The problem is studied from the viewpoint of cost, service life, design. It is necessary to consider in this service life the kind of load. Load conditions do not in general exist in what might be termed the pure state but in most cases exist in fairly intricate matter and in some cases an exceedingly complicated matter. Before proceeding to the consideration of the complicated problem, it is well to give some thought to the load conditions from the elementary viewpoint and then follow this up with a combination of the various elementary load conditions as they contribute to the service performance and cost reduction.



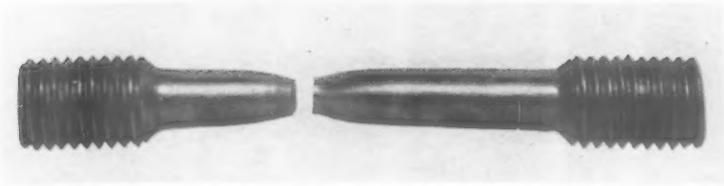
This 20,000-lb. welded machine structure was fabricated at a saving of $437 under cost of castings and patterns.

There is, of course, the pure load condition such as tension, compression, bending. These loads seldom exist in a single state, but are generally combined in some manner usually characteristic of the service to be performed. Tension, compression, bending, etc., are thought of as being the results of load conditions, but no mention is made, nor are the rates of application of the load suggested merely by the mentioning of tension or compression. There is, of course, the dead load, steady or continued loading, such as the weight of a beam which has been placed in position. Then there is the gradual application of load such as the addition to any piece of equipment of devices or attachments which do not have purely a load carrying function.

Impact Loading

This may be illustrated by the addition of the floor system to beams. This is very, very gradually applied. The rate of application of the load may be gradually increased until what is termed an "impact" or "shock" load, an exceedingly rapid application of the load is reached. It is almost self-evident that in the case of the very slowly applied or steady load the conditions

This article is a revision by the author of a paper he presented at the annual meeting of the Association of Iron & Steel Engineers, held in Chicago, September 27-30, 1937.



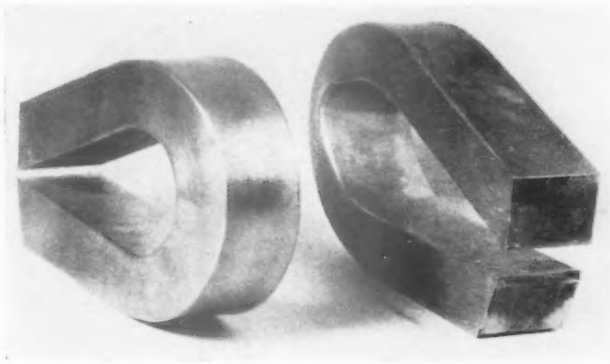
Standard .505 in. diameter tensile test specimen machined from weld metal. Cupping in before fracture indicates good ductility.

are very much different than they are when the load is applied very rapidly. The ability of weld metal and welded joints to meet these conditions as given above is illustrated by the pure tensile specimens, the bending specimens and by the impact specimens. It is to be noted that the impact specimen shows by the type of fracture an exceedingly high value (from 40-80 Izod). The rate of application is one load condition which must be very thoroughly studied and considered in the application of design to any piece of equipment.

Frequency of Load

There is also the frequency of the application of the load. The frequency of application must not be confused with the rate of application. Impact load is a very high rate of application, but may be applied very infrequently. There is the relatively slow and rather infrequent applications of the load such as exists in the case of a stamping press or bending brake. Other types of loads are such that the load is applied a great many times, such as the load existing on a punch press, or reciprocating parts of all kinds. This frequency of application has a most decided bearing upon the characteristics of the design.

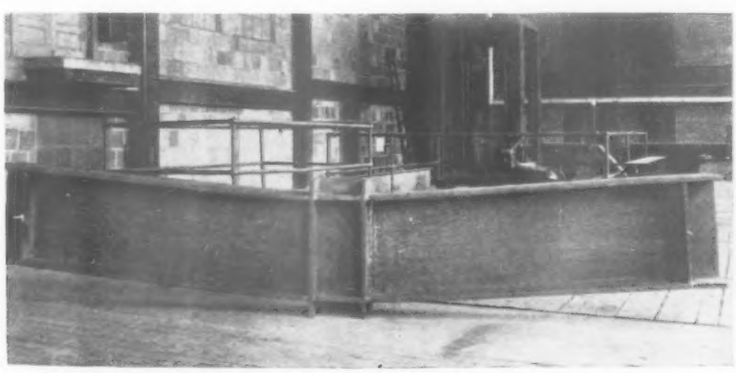
The variation of the load must also be taken into account, that is, from tension to compression or from a high tension to a lower tension, or from positive to negative bending or from positive to negative torsion. It has been found that when the load is very rapidly changed and the frequency is very high, or a great number of reversals occur, that the stress distribution becomes a factor which must be carefully studied. There are, therefore, a number of guides in the application of the type of construction used. The tension, the compression, the impact and the fatigue, the rapidly reversing load. The ability of the welded joint to withstand the load, is determined by a fatigue specimen.



Free bend specimens indicate degree of ductility of weld metal and strength of fusion zone.

Stress Distribution

As mentioned above all of these load conditions must be studied and the relation of the stress distribution in connection with this load must be given attention so that as uniform a stress as possible will be attained. It is obvious, of course, that if even the smallest section for a very small distance is stressed beyond the tensile strength it will tear or break; that if even in the smallest section subjected to continued reversals, the stress exceeds 32,000 lbs. p.s.i. it will fail in a relatively short time. Welding fabrication permits uniformity of stress distribution and consequently the utilization of metal to best possible advantage. This ability to perform and meet the service or load condition of welded metal must, of course, be utilized at a low cost.



Deformation test of welded girder connections to obtain satisfactory evidence of strength of welded joints.

Cost Factors

This cost is made up of several different items,—power, the cost of electrode, the cost of labor, and the resultant quality or ability of the joint to meet load conditions. All of these must be taken into account when consideration is given to the item of total cost and service life.

It is well known that large generators are more highly efficient than smaller generators, consequently the larger generator should be used. It is a characteristic of a welding motor-generator set that the efficiency curve is relatively flat over a fairly large range of operation. There are several sizes of arc welding generators, but as an example a 300-amp. motor generator has an efficiency of 47% at 110 amp., 25 volts; 59% at 370 amp., 38 volts. At the lower ranges the efficiency is not appreciably less than that of smaller machines. Consequently, this wide range and high efficiency of the large motor-generator set means a lower cost for power.

Cost of Electrodes

At the normal rated current it is discovered that it takes from 75 to 90 sec. to consume an electrode. It is evident, therefore, that if larger size electrodes are used that more metal may be deposited. Table No. 1 indicates this with reference to a series of different sizes of electrode, indicating very clearly the higher rate of deposi-

TABLE 1—Electrode Sizes and Costs

	1/8	5/32	3/16	1/4	5/16	3/8
Labor	57.60	45.40	38.00	20.00	14.00	9.20
Power	6.51	5.91	5.81	5.45	5.28	5.07
Electrode	15.75	14.75	12.75	12.75	12.75	12.75
Interruptions	5.40	3.60	2.40	1.50	.90	.60
	57.60	45.40	38.00	20.00	14.00	9.20
TOTAL COST PER LB.	142.86	115.06	96.96	59.70	46.93	36.82

Labor $0.75 per hour; Power .02 per kwh.
50% operating factor; Overhead 100%.

tion for the larger electrode and consequently the decidedly lower labor cost. Just the change from 3/16 in. to 1/4 in. electrode would involve a cost reduction of 25% to 35%. This is a more or less self-evident statement. However, just because an electrode is consumed in a certain time is no reason to believe that it is the most satisfactory.

Cost of Deposited Metal

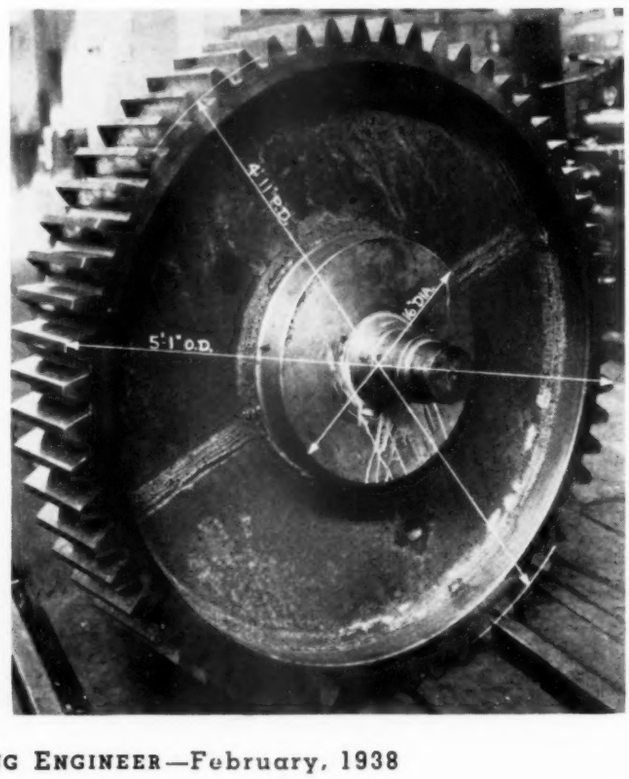
Table No. 2 indicates a tabulation showing that a variation in performance is of vital importance. To obtain a satisfactory joint, it is necessary that the metal be *deposited in the bead* and join the two parts involved. Therefore, the cost of this *deposited metal* should be considered on the basis of the amount of the metal which is *deposited*, not upon the cost per pound of the electrode *purchased*. Consequently the comparison should be made between given size electrodes for the conditions required, as for example the *deposition* of 100,000 lbs. of metal. Note the tremendous difference in cost, due to the difference in performance of the electrodes.

As previously mentioned, service life and dollars and cents cost, must go together to make up the cost item. In the fabrication of parts, the matter of expansion and contraction, should be considered. It is found that the use of a few beads has a tendency to reduce the distortion as compared to the amount of distortion obtained by using a greater number of smaller beads. This, of course, is an advantage obtained by the use of larger electrodes.

Higher Ductility

It is also found that the use of the larger electrode results in the production of weld metal of higher ductility than is obtained when a relatively large number of small beads is used. The reason being, of course, the difference in the cooling rate obtained, or to put it another way, if a certain speed of travel and a certain current produce in the metal adjacent to the weld a certain definite change, such as hardness, then if the speed is doubled without changing the current this hardness is increased. If the current is doubled and the speed is doubled, the hardness is not materially changed.

Toughness of welded connections dramatically demonstrated by a severe impact test on a box section. No evidence of weld failure.



A saving of $57 was effected by welded fabrication of this 5,500-lb. gear. Selection of steels to meet specific uses is made possible by welding, thereby effecting a saving in weight.

Lower Cost Per Lb.

Therefore, it would seem that in the matter of cost that the use of the larger electrode at high speed produces a deposit at a lower cost per pound, and in addition to that the quality is of an exceedingly high order. It is high in ductility, with less distortion, and it is therefore advisable to use the largest size electrode which the

TABLE 2—Cost to deposit 100,000 lbs. of weld metal

Electrode No.	(1)	(2)
Amperes	280	280
Volts	30	30
Rod Efficiency	66.7%	55.8%
Operating Factor	50%	50%
Lbs. Deposited Per Hour	4.29	3.13
M. G. Set Efficiency	62%	62%
KWH. per Lb.	1.737	2.38
Hours to Deposit 100,000 lbs.	23,310	31,949
KWH. to Deposit	173,700	238,000
Electrode Required, Lbs.	150,000	179,000
Cost of Labor	$16,317	$22,364
Cost of Power	$3,474	$4.760
Cost of Material	$12,750	$15,215
Total Cost	$32,541	$42,339
Cost per Lb.	$ .325	$ .423

design or fabricated part will permit. It is to be very carefully noted that this limitation or qualification is placed upon this statement and in addition to that it is also to be carefully noted that in general the tendency is toward the use of too small electrode, consequently high costs.

Arc-Welder Cuts Production Cost

In Everett, Mass., the Standard Mailing Machines Co. finds, in the manufacture of gear and cam assemblies for duplicating machines, that the use of a low-current arc-welder makes possible an 85 per cent cost reduction. D. R. Hoover, production manager of the Duplicating Machines Division of the company, further states that the welder improves the quality of the product.

Welder at work on gear and cam assembly of new process duplicator.

Technical Program Planned for Western Metal Show

In conjunction with the Western Metals Exposition, the Pacific Coast Sections of the American Welding Society, and American Society for Metals, will hold a series of technical meetings March 21-25, 1938. It is expected that this event will draw a large number of metal and welding experts from the Western section of the United States.

The Pacific Coast Sections of the A. W. S., working in conjunction with A .S. M., will provide an imposing list of Western experts on practical welding applications. The A. W. S. meetings will be held at the Biltmore Hotel in Los Angeles (9:00 a.m. to 12:00 noon). The Western Metals Exposition will be in the Pan-Pacific Auditorium (12:00 noon to 10:00 p.m.).

E. F. SCATTERGOOD, general chairman of the conference committee, is chief electrical engineer and general manager of the Los Angeles Municipal Bureau of Power and Light.

A series of five educational and informative lectures on the manufacture, treatment, and application of iron and steel will be presented by Dr. A. Allen Bates, noted lecturer, teacher and research worker. Dr. Bates was formerly professor of metallurgy at Case School of Applied Science, Cleveland, Ohio. He is at present manager of the chemical and metallurgical department of Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.

The exposition and lectures will cover every modern welding and cutting procedure, equipment and supply as well as all of the innumerable test procedures and equipments for the basic raw materials utilized in all of the industries whose products are designed for and fabricated by welding.

Monday, March 21st

9:00 a.m.—Opening Session

P. D. MCELFISH, Chaiman, Standard Oil Co. of California

T. C. SMITH, Vice-Chairman, General Petroleum Corp.

Symposium on Welded Oil Well Casing Strings

Weldability and Properties of Materials for Casing Strings
ISAAC HARTER, Babcock & Wilcox Co.

Field Practice in Welding Casing Strings
HOWARD NEWBY, Superintendent, American Pipe & Steel Corp.

Physical and Economical Advantages of Welded Casing Strings
The Shell Oil Company

E. F. SCATTERGOOD

12:00 Noon Luncheon Meeting

K. V. KING, Divisional Vice-President, presiding

Welcome Address, E. F. SCATTERGOOD, convention chairman

Introduction of national and divisional officers by Mr. King

Address by P. G. LANG, JR., president of the American Welding Society

12:00 Noon to 10:00 p.m.

Metals Exposition, Pan Pacific Auditorium

Tuesday, March 22nd

9:00 a.m.—Conference Session

JOHN MCCONE, Chairman, Bechtel-McCone Corp.

C. W. ROBERTS, Vice-Chairman, Southwestern Engineering Co.

Design and Fabrication of High-Temperature and High-Pressure Piping
F. C. FANTZ, The Midwest Piping & Supply Co.

Reconditioning Existing Pressure Vessels to Meet Present Day Safety Standards
K. V. KING, Standard Oil of Calif.

Stainless Alloy Welded Plate and Castings Combined in Corrosion Resisting Pressure Equipment
RICHARD JAMESON, Electric Steel Foundry Co., Portland, Ore.

Welded Plate Construction for Machinery Bases and Substructures
RICHARD YOUNG, Bethlehem Steel Co.

12:00 Noon to 10:00 p.m.

Metals Exposition, Pan-Pacific Auditorium

Wednesday, March 23rd

9:00 a.m.—Conference Session

C. M. ALLEN, Chairman, Los Angeles Bureau of Light & Power

C. P. SANDERS, Vice-Chairman, Western Pipe & Steel Co.

Symposium on Large Welded Pipe for Water & Power Transmission

Design of Large Welded Pipe, Laterals and Supporting Structures
DR. W. F. DURAND, Stanford University

Shop Fabrication and Spinning of Protective Coating
L. M. MUFFLER, Consolidated Steel Corp.

Field Erection and Inspection
Southern California Metropolitan Water District

12:00 Noon Luncheon Conference
WARNER S. HAYS, Managing Director, The American Welding Society, presiding

Memberships, programs and organization problems of the Society and of the Sections will be discussed

12:00 Noon to 10:00 p.m.
Metals Exposition, Pan-Pacific Auditorium

Thursday, March 24th

9:00 a.m.—Conference Session
R. W. BINDER, Chairman, Bethlehem Steel Co.

O. G. BOWEN, Vice-Chairman, Consulting Structural Engineer

Design of Welded Connections in Building Construction
PAUL JEFFERS, Consulting Structural Engineer

Resistance Welding Processes and Their Application
STANLEY LEVYNE, Acme Electric Welder Co.

Problems in Welding Light Gage Materials
Linde Air Products Co.

12:00 Noon to 10:00 p.m.
Metals Exposition, Pan-Pacific Auditorium

7:00 p.m.
Dinner Dance, Biltmore Bowl, Biltmore Hotel

Friday, March 25th

9:00 a.m.—Conference Session
N. F. WARD, Chairman, University of California

LLOYD EARL, Vice-Chairman, Consolidated Steel Corp.

Application and Proper Use of Hard-Facing Materials
DON LLEWELLYN, Air Reduction Sales Co.

Welding Cast Irons
PROF. GILBERT S. SCHALLER, University of Washington

Characteristics of Slags, Their Application to Electrode Composition and Effect on Welding
DR. WELTON J. CROOK, Stanford University

Helping the Small Job Shop Welder
J. C. GOWING, J. C. Gowing Co.

Inspection of Welds and Supervision of Welding Operators
RUSSELL GRAVES, Union Oil of California

12:00 Noon to 10:00 p.m.
Metals Exposition, Pan-Pacific Auditorium

Indications point to a large delegation from all Pacific Coast divisions. This will be an exceptional opportunity to get first-hand information on the latest procedures and also to contact prominent men in the welding and metal industries. The meetings will be open to engineers, metallurgists, welders, designers or anyone interested in the practical application of welding.

Equipment Exhibitors

A partial list of exhibitors of equipment related to the application of welding processes is given below. This list was released as of January 10th and cannot be taken as complete:

Air Reduction Sales Co., 60 E. 42nd St., New York City

American Steel & Wire Co., 208 S. La Salle St., Chicago

Bastian-Blessing Co., 278 E. Ontario St., Chicago

Bethlehem Steel Co., Bethlehem, Pa.

Carnegie-Illinois Steel Corp., Pittsburgh, Pa.

Columbia Steel Co., San Francisco, Calif.

Electro-Metallurgical Co., 30 E. 42nd St., New York City

General Electric Co., Schenectady, N. Y.

Haynes-Stellite Co., Kokomo, Ind.

International Nickel Co., 67 Wall St., New York City

Lincoln Electric Co., Cleveland, O.

Linde Air Products Co., 30 E. 42nd St., New York City

Ludlum Steel Co., Watervliet, N.

Marquette Mfg. Co., Minneapolis, Minn.

Metallizing Co. of America, Los Angeles, Calif.

National Carbide Corp, 60 E. 42nd St., New York City

Norton Co., Worcester, Mass.

Republic Steel Corp., Cleveland, Ohio

Stoody Company, Whittier, Calif.

Stuart Oxygen Co., San Francisco, Calif.

Union Carbide Co., 30 E. 42nd St., New York City

United States Steel Corp., Pittsburgh, Pa.

Victor Equipment Co., 844 Folsom St., San Francisco, Calif.

Welding Engineer (The), 608 S. Dearborn St., Chicago, Ill.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Wilson Welder and Metals Co., North Bergen, N. J.

J. J. Crowe—New President of C. G. M. A.

Announcement of J. J. Crowe's election as president of the Compressed Gas Manufacturers Association is published elsewhere in the news columns of this issue. We publish here a sketch of Mr. Crowe's professional background. After graduating from McKinley High School in Washington, D. C., Mr. Crowe went to work at the Bureau of Standards as an apprentice and continued his education by attending evening classes at George Washington University. While at the Bureau of Standards, Mr. Crowe collaborated with Dr. Burgess and Dr. Waidner in the publication of a number of papers on thermometry, pyrometry, and metallurgy.

Later Mr. Crowe was advanced to the position of associate physicist in charge of a section. In 1915 Mr. Crowe was loaned to the Navy Department for the purpose of rendering metallurgical assistance in the development of anchor chain at the Boston Navy Yard. Up to this time the large chain used on the anchors carried by the battleships was forged and welded by manual labor. The development consisted largely in replacing the hand-hammer operation by power-hammer operation and the proper heat treatment of the finished chain to obtain the best possible results under the se-

J. J. CROWE

vere service to which this chain is subjected. Work at the Boston Navy Yard was not limited to the development of anchor chains, but included supervision of the heat treatment of all of the forgings and the establishment of a physical testing and metallurgical laboratory at this yard. This laboratory was the first metallurgical laboratory established in any of the Navy Yards, it is claimed.

Philadelphia Navy Yard

Instead of returning to the Bureau of Standards he accepted an appointment as physical metallurgist with the Navy Department and was transferred from Boston Navy Yard to Philadelphia Navy Yard. He established at this latter yard another metallurgical laboratory and assisted in the establishment of similar laboratories at both the New York and Norfolk Navy Yards. The Naval Aircraft factory at Philadelphia Navy Yard was just beginning production and there were many metallurgical problems which arose and this work was sandwiched in with other work at the yard.

It was at the Philadelphia Navy Yard that Mr. Crowe had his first real contact with the practical application of fusion welding and cutting by the oxy-acetylene process. By applying the oxygen cutting process in the forge shop, great savings were made in cost of producing large forgings and fusion welding was used to advantage not only in the forge shop but in the foundry.

In 1921 working as a representative of the American Society for Metals, Mr. Crowe persuaded Temple University (Texas) to establish a course in metallurgy. This was done and Mr. Crowe was given the position of director of this department at Temple University and served in that capacity until 1924. In that year he accepted the position which he now holds, namely, Engineer in Charge of Apparatus Research and Development for Air Reduction Co., Inc.

Since his connection with Air Reduction Co., Mr. Crowe's activities with the American Society for Metals, American Institute of Mining & Metallurgical Engineers and American Society for Testing Materials have not only been continued but have been increased to include the American Welding Society, of which he is a past president, the Compressed Gas Manufacturers Association and the International Acetylene Association.

World's Longest Horizontal Self-Supporting Pipe Span

Until the two spans of pipe shown in the accompanying illustrations were constructed, a pipe span of 100 ft. was unheard of. The spans illustrated here are each 105 ft. long. The structure carries sewage across the Platte River to the new sewage disposal works at Denver, Colo. This is to be the longest unsupported span of pipe in the world. It was made possible by new theories in the design of supporting metal pipe which have led to use of a new method of construction.

The principle involved in the construction of such long spans is that of preventing distortion at the points of support by welding stiffener rings to the pipe. These rings transmit the load to the foundation by means of legs attached to them. Use of the new method of construction demonstrated a saving in cost of 22% over the next most economical design, and offered less obstruction to flow inside the pipe.

The pipe is 78 in. in diameter, and ranges in thickness from 5/8-in. to 1 1/8 in. The stiffener ring at the center pier is a 12-in. per 40-lb. I beam rolled edgewise. The legs on this ring are rigidly fastened to the center pier. The stiffener rings at the ends of the pipe are 10-in. per 30-lb. I beams. The legs on these rings rest on patented rollers. An expansion joint in the wall at each end of the pipe allows it to expand both ways from the center. All seams were butt welded electrically.

The pipe was designed as a continuous structure for a maximum combined fibre stress of 9,800 psi. in the pipe shell, and 16,000 psi. in the stiffener rings. Maximum negative bending moment at the center pier is 4,138,000 lbs.-ft.

The pipe was designed, fabricated of copper molybdenum iron by electric welding and erected by the Thompson Manufacturing Co. of Denver, Colo. The welding was done by the shielded arc process with equipment manufactured by The Lincoln Electric Co., Cleveland, Ohio.

These 105-ft. pipe spans are longest unsupported lengths of record.

Welded Crankshaft Repair

From far off Syria, the town of Aleppo, comes this photograph illustrating the crankshaft of an 85-hp. Diesel motor boat. The shaft was broken in two pieces and repaired with electric welding by Leon Babloozian, a native Syrian. After the welding was completed, the shaft was put on a lathe and it was found to be only one millimeter out of true from center to center. Repairs were made approximately three months ago and the shaft has been operating satisfactorily ever since.

Diesel engine crankshaft repaired in far off Syria by electric welding.

Helpful hints to

help you

Choose A Welding Glass

★ Should a welding glass be selected on the basis of its color? Do you think a glass is safe if it seems "dark enough"?

By H. R. MOULTON

Assistant Director of Research. American Optical Co., Southbridge, Mass.

DO YOU CHOOSE a pair of welding goggles or a welding plate by the color alone? If you do, you may be trusting the safety of your eyes to a glass that's not much better than an ordinary sheet of window glass. Scientists in the laboratories of welding glass manufacturers have thoroughly exploded the old myth that "any glass is all right so long as it's black."

A piece of colored glass may be able to fool the eye—for a few minutes or even a few hours—but it can't fool laboratory devices known as spectrometers aand thermopiles. And the laboratory data leaves no doubt about it—too many welders have been too trusting about the welding glasses they have been using. Carelessness, overwork, or "weak eyes" may not be responsible after all for those splitting headaches, hot sand in the eyes, and lost time. A welding glass that looks all right, but isn't, may be the cause of the trouble.

The most important thing to know about welding glass is this: it's the chemical composition (not the color) that makes the difference between a safe glass and a worthless glass. A welding glass may be as black as midnight, but if its chemical composition is not right, it can let through enough of the dangerous rays to do real damage to your eyes.

Nature of Light

To understand why a welding glass should have certain chemical properties, it is necessary first to understand something about the nature of the light that comes from a welding flame or arc. In the simplest terms, the light can be thought of as consisting of three main parts. First, the infra-red part is made up of extremely long light waves, so long that they are invisible to the eye (from 5,000 down to 760 millimicrons). The next, or the *visible* part, is made up of waves of moderate length visible to the eye (from 760 down to 360 millimicrons). The human eye can respond only to this band in the middle and does its best seeing on waves near 550 millimicrons for equal energy spectra, but the maximum emission for melted iron is about 570 millimicrons. This visible range includes all of the colors we ordinarily think of—red, orange, yellow, green, blue. Finally, there is the ultra-violet part, made up of extremely short waves (from 360 down to 185 millimicrons or less). These, like the infra-red, are invisible. Figure 1 shows how these three parts line up.

Notice that the useful visible rays form only a relatively small proportion of the entire light coming from the arc or flame. The rest of the spectrum is not only useless for illumination, but is capable of doing tremendous damage to the eye.

"Hot sand in the eyes," painful as it is, is only one of the less serious effects of exposure to ultra-violet rays. Scientists are actually using ultra-violet rays to break down protein in laboratory work. *The eye is made up of protein.* There have been actual cases of permanent loss of sight through a terrific flash, high in ultra-violet rays, close to the eye. The ultra-violet rays simply broke down the protein in the eye and the sight was destroyed. "Hot sand in the eyes" is nothing more nor less than a kind of sunburn. Like ordinary sunburn, the burning sensation is usually felt an hour or two after exposure.

Infra-Red Rays

Infra-red rays have a different effect. During exposure to them the cornea, the crystalline lens, the iris get a slow cumulative "cooking." There is good medical evidence that this "cooking" may be one of the causes of cataract.

A good welding lens, then, has several different jobs to do:

(1) It must cut off all of the useless and harmful ultra-violet rays to prevent "hot sand in the eyes" and pos-

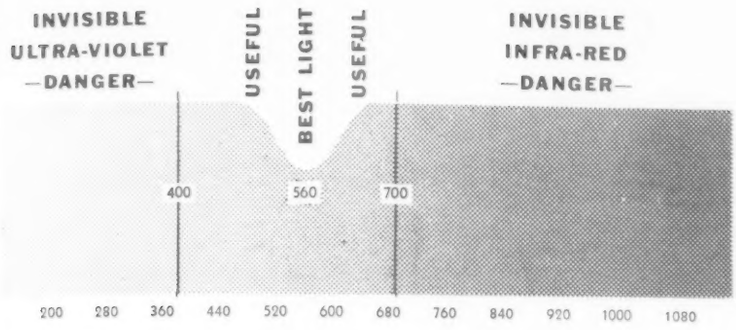


FIG. 1—The human eye gets more light from a welding arc than is visible. This is a diagrammatic map of the various wave lengths of light received from a welding arc or flame. Range of wave lengths in millimicrons is shown across the bottom.

sible permanent injury (especially with arc welding).

(2) It should cut off all of the infra-red rays to prevent the slow "cooking" of the eyeball.

(3) At the same time it must let through just enough of the harmless and useful rays in the middle of the visible spectrum to give a good clear view of the work.

How good welding lenses do these three jobs can be seen clearly from Fig. 2. The numbers across the bottom of the chart show the wave lengths of the light from the arc, ranging from 280 millimicrons in the ultra-violet up to 790 millimicrons in the infra-red. The heavy black line represents the proportions of light of the different wave lengths that are transmitted. Notice that the glass lets through none of the ultra-violet, practically none of the infra-red, but still lets through a very good proportion of the useful light, particularly in the green and yellow where the eye is most efficient —over ten times as efficient as it is to violet and red. This glass lets through maximum light at the point (570 millimicrons) where the efficiency of the eye is greatest for the melted iron radiation. Hence this glass will protect the eyes and at the same time give good visibility.

The dotted line on the chart shows the percentages of the various kinds of light that would be transmitted through an ordinary piece of dark glass.

The difference is all in the chemical composition. There are mineral salts which are known to absorb ultra-violet rays and other salts which are known to absorb infra-red. By using the proper quantities of these two salts, in exactly the right proportions, and by employing exactly the right kind of melting methods, the first-line manufacturers have succeeded in making an optical "sieve" which screens out all, or virtually all, of the harmful rays, but still lets through the useful ones.

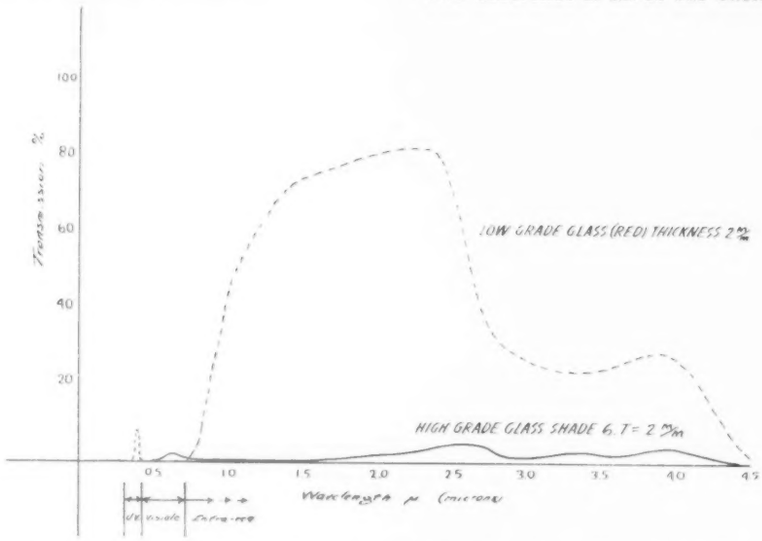


FIG. 2—One welding glass may look as dark as another, but these curves, drawn from data obtained with delicate instruments, portray the difference. Heavy black line shows the percentage of light transmitted by a high grade welding glass. The dotted line shows a typical transmission test on a low grade welding glass. This glass lets through less of the useful light than the good grade. At the same time it lets through damaging quantities of ultra-violet and infra-red rays.

TABLE 3—Typical Test Results on Different Welding Glasses

	Ultra Violet Transmission	Visible Light Transmission	Infra Red Transmission
1. Noviweld No. 8	none	0.1%	0.01%
2. Low grade glass of the same shade	10%	0.1%	35%
3. Calobar (dark)	none	36%	less than 12%
4. Low grade glass of approx. same shade	up to 50%	36%	30% to 80%
5. Noviweld No. 14	none	0.003%	less than .01%
6. "Black Glass"	up to 50%	0.001%	30% to 70%
7. Calobar (light)	none	67%	less than 40%
8. Low grade glass of approx. same shade	up to 50%	67%	50% to 88%

NOTE: Low grade glasses are very irregular. Some have fairly low ultra-violet transmission, others very high. Practically the same statement holds for the infra-red transmission, although this rarely is low. The values given are probable values.

The first lens of each pair is a first quality lens made by a reputable manufacturer, the second of the pair being a low grade lens. These figures tell the difference between a well protectd pair of eyes, and a pair of eyes that will give trouble and cost money.

Results of Lens Tests

Table No. 3 shows the actual figures obtained in a recent test of a group of goggle lenses. A minute or two spent in studying this table will indicate how dangerous it is to rely upon the color of glass as an indication of its safety. Judging by color alone, you might pick out glasses 2, 4, or 8. They are the same color, or even darker, than the other glasses listed. Actually, each of these so-called welding glasses lets through enough ultra-violet and infra-red to do your eyes serious harm, espe-

cially if you are doing any work with the high intensity arcs that are coming more and more into use.

The question arises, if you're not equipped with the ultra-violet spectroscopes, the photometers, the spectrophotometers that are used to measure the light transmission through glass, and with thermopiles and galvanometers, how are you going to be able to choose a welding glass for your own use with the certainty that it will really protect your eyes? The answer is, of course, that you'll have to take somebody's word for it. Fortunately there are several suppliers of goggle lenses and welding plates, who furnish detailed information and transmission data on the glasses they sell. This data can be relied upon. Pick out a company you can trust, then choose the shade of glass that meets your specific requirements.

If you have not given much thought to welding lenses in the past, do so now—for your eyes' sake. There are several good welding lenses on the market. The good ones cost very little more, if any, than inferior lenses. In the long run they will save the most important possession you have—your eyes.

Get H.O.T. On Welding

By H. O. T. RIDLON

On Going About and Reading

Yes, that's about what my job consists of, going about and reading things. And the other day there came over my desk the January issue of the SOUTHWESTERN WELDER AND BLACKSMITH. Well I wish I were bold enough to reprint word for word an article in there entitled "Plea for a Broad-minded Organization," by Karl W. Bayer, Shattuck, Okla. It is so worth-while I wish every one of my three or four readers would read this article. Yep, I think Mr. Bayer really has something there, and I want to extend my "congrats" to the gent, and say, Pal, I'm for yah!

As I am going about over some six or seven states, or is it ten, calling on large plants, little plants, big welding shops, cross-road blacksmith shops, tinker shops, talking to mastercraftsmen and dubs, the great, the near great, and the would-be-great of our industry, I get a fairly broad view of what is going on about, because I was taught long ago not only to read what is on the printed page, but what I see, and to read between the lines of what I hear. So I'm telling you lugs this gent Bayer really knows what he's telling you in this grand article of his.

Have devoted some thought recently to the well known fact that welders are not classed as a trade. And that it is generally considered by Mr. and Mrs. Populi and Populorum that there isn't much to welding and that any punk can pick up a torch or electrode holder and do a first-class job. That always gives me a big laugh, but so help me Hannah, it is true. So, if we won't go out now and sell the public what we are, we never will amount to anything.

We have to establish professional ethics and live up to them like the doctors and lawyers do. Those lads really do put that stuff over, and how, in a big way. I've always had a dream about an association, The Welder's Guild—like the guilds of master craftsmen we read about in our history books—where for a nominal fee a welder could become a member.

Qualifying Welders

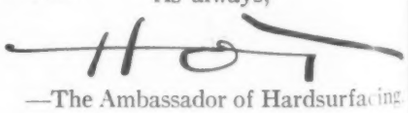
In every industrial center there would be a testing station where a welder could come and qualify for a particular type of job. Pipe welder, production oxy-acetylene or arc welders, job shop welders and so on down the line, all would be classified, listed, and given cards stating their qualifications. The welder would have to pay a nominal fee for taking the tests. And to The Welders Guild, the man who wanted to employ a welder would come, knowing that he would get the kind of a welder he wanted, and only there would he would get them. To get them, he would have to pay a small fee for the service extended by The Welders Guild. The welder would not be paying money to get a job. The entire thing would be on the "up and up," for the welder and by the welder, to do the welder and job shop owner some good.

The other night I went to the International Air Show here in Chicago. It sure was a swell layout for anyone that is inclined to be air-minded. And there were plenty of displays of some mighty high-class welding. They just don't allow any bum welds for the guys that fly around in God's Heaven. Any welder that hasn't seen a real aircraft welder do his stuff, really should make a point of seeing it, because those boys sure can lay that stuff in there.

Spring

Yes Sir, when this rolls off the press it will be only a few short weeks before the crocuses will be croaking, and the daffodils will be dilling, or something, and a young man's fancy turns to something or other and a lot of you job shop owners will be wishing for a lot more business. So what!! And rightly so. But now, today if you can tear yourself from these words of wisdom, you should crank up the old jitney and take yourself out into the open spaces and away from the old stove and call on your good neighbor, the farmer, and tell him about all the wonderful things you can do for him, like hardsurfacing his plow shares, corn planter shoes, and so on and on. Tell him how much money he will save, if he will let you take them right back to your shop with you and not wait until he is ready to use them. Then you'll have them all set, when he's ready for them. Build the story of profit to him.

There is no end of things on the farm that can be made to last 3 to 10 times as long by hardsurfacing and this spells profit to the farmer. There are also many metal parts that can be repaired or built up by welding that will save that farmer friend of yours lots of bucks, because he won't have to buy new ones. Then there are lots of things you can build for him, such as new gates out of scrap pipe, hog troughs out of old hot-water boilers, etc. Then on the way back to town, stop in and see the road contractor and the county highway department and tell them more about hardsurfacing. Another swell job to get them started on, is scarifier teeth. Well if you want to, you can sit about for days telling them all the good you can do for them. But you've got to tell them. They'll never in God's green world guess it themselves. Sell them the big idea—Profit! As always,



—The Ambassador of Hardsurfacing.

FIG. 1—This propeller has worn out in a relatively short period in government dredge service.

Salvaging operations prove

Economy of Metal Spraying

★ This process accomplishes a mechanical union and not a fusion—By proper surface preparation an almost solid deposit of metal can be sprayed on

By WILLIAM P. KENNEDY

General Manager, Brodie System, Inc., Brooklyn, N. Y.

INTEREST IN THE practical possibilities and usefulness of applying one metal to another or of building additions of the same metal to improve wearing qualities, correct defects, or restore surfaces deteriorated by erosive, chemical or frictional effects, has increased the demand for more information on the subject. Certain repeated practices have reduced metal spray application to a rigid routine in particular lines of salvaging operations in which there is great economy and little risk; provided workmanship and materials are first class.

These may be classified as convex cylindrical applications to machine parts having bearing surfaces, such as engine crankshafts, camshafts, piston pins, rockshafts, valve stems, pump shafts, pistons, tailshafts on ships and rolls used in industrial operations. Fairly staple standardization has also been established in what may be termed concave cylindrical operations in which sprayed material is applied to internal surfaces. Generally, these are tanks, troughs, containers, mixing utensils, large tubing or pipe fittings. More exact requirements have to be met in engine cylinder relining to restore them to original size, and also with annular housings into which are fitted ball and roller bearing assemblies.

Beyond these common applications there is a fascinating field of variety that intrigues the toughest and most hard-boiled veterans of the machine shop, the engine room or the mechanic arts in general. It often happens that what seems to be a hopeless mechanical wreck can be immediately restored to usefulness, with all the beauty and charm it formerly possessed as a brilliantly shining part destined by its designer to accomplish a specific purpose.

In other words, the molten metal spray gun is something akin to, if not yet on a par with, the acetylene torch, which has become such a versatile device in metal manipulation. True, the metallic union effected by each device is different, with advantages and disadvantages on both sides. But, used in conjunction with each other, or collaterally in the many useful fields of metal fusion, these two devices have almost untold possibilities in salvaging operations, fabricating and finishing.

Thermal Effects Avoided

While the advantages and disadvantages of the torch are well understood; it may be stated in favor of the gun that its operations are performed comparatively cold with avoidance of such temperature effects as, expansion, contraction, distortion or internal stress. On the other hand, a mechanical rather than a fused union is accomplished, although by adequate surface blasting and immediate spraying, controlled with regard to quantity and quality of spray flow, an almost solid deposit of metal can be effected.

Common belief is that each molten metal particle, or globule, maintains its separate entity in its ejection from the nozzle of the gun, during its flight

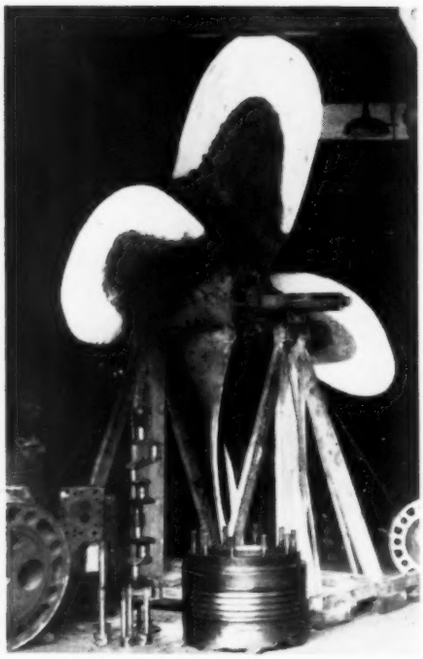


FIG. 2—Same propeller as shown in Fig. 1, but with surface contours fully restored—white areas indicate sprayed treatment.

across the space between the gun and the base metal of the object; and during its subsequent solidification on the object. There are other equally believable theories, verified by magnified photographic examination, that, when the molten particle reaches the object, it coalesces instantly with other neighboring molten particles and forms a gradually extending continuous mass which is homogeneous within itself.

Cylindrical Spraying

On cylindrical objects, rotated in the process of spray application, this gradually accumulating mass is formed within the field or area sprayed by the gun. As the object rotates, the molten area or region sprayed passes out of range of the heat of application and cools off with solidification gradually taking place, but with an effect that is practically instantaneous. The gun moving slowly parallel to the axis of the object's rotation, deposits the sprayed material spirally around the object, each rotation causing a slight overlapping of the path previously sprayed, the edges obviously being thinner than the central region of the zone covered.

It will be recognized that the layer of sprayed material is applied like a spiral bandage. With the reverse movement of the gun in applying the next layer, the direction of rotation of the bandage—so to speak—is opposite; and likewise for each alternate layer; until the required thickness has been applied.

Cross-sectional photographs through the above described laminated layers, sufficiently magnified, discloses each layer distinctly, due to the fact that during rotation away from the gun the surface being heated has slightly oxidized, just sufficient to make the demarcation evident. Precautions must be taken to perform a continuous and uninterrupted operation in the least time possible, keeping the flow of spray from the gun even and at maximum density, the distance from the nozzle to the object sprayed being constant.

Disappointing Experiences

Many condemnations of the metal spraying art by those who have been disappointed in their expectations are due to careless and spasmodic applications by cock-sure performers. Incidentally, it will be noted from the foregoing that with proper blasting the molten particles in the first application imbed themselves securely within the surface identations. If intimate fusion between the particles takes place as described, the first layer is securely locked or keyed to the base metal. The subsequent layers being applied in reverse spiral order, the whole constitutes a bonded mass fixed and irremovable in any normal employment and capable of rendering a reasonable return for the precautions and cost involved.

It will be understood that the softer metals adhere and form better (less porous) unions than the harder and more brittle metals. Since all metals consist of crystalline grains their structures, if sufficiently magnified, would appear like coke (or perhaps a petrified sponge would be a better example). They are, therefore, relatively porous. Now, when we build up a surface by packing a lot of grains together by the spray method, this porosity becomes accentuated, and it is necessary to seal over the surface by some sort of finishing operation. A wire brush finish is the simplest. Turning, grinding and final buffing are relatively better. These operations close the pores. Lacquers and other types of filler finishes are used where artistic and decorative effects are desired, in which cases the sprayed surfaces need not be finished.

Spraying Flat Surfaces

In spray applications to flat, irregular, or non-cylindrical surfaces, care must be taken to simulate the conditions described in the foregoing relating to cylindrical surfaces. Hard flat surfaces subject to friction require caution. Sharp edges, such as keyways should be avoided unless studding along the edges is allowable. Spline restoration following wear is not feasible. In general, wherever tensile stress or sliding frictional contact exists, sprayed applications are not satisfactory.

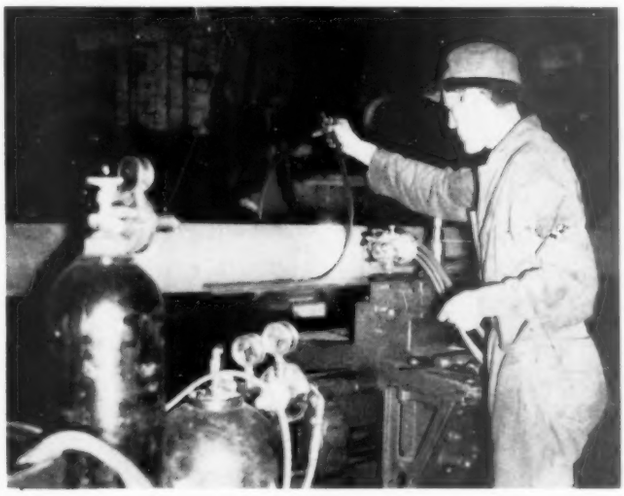


FIG. 3—Restoring bearings of 13 ft. by 8 in. tailshaft by use of metal spraying.

A few illustrations show what can be done in unusual instances. Figure 1 is a propeller worn out in government dredge service within a relatively short period. An experiment is being undertaken to prolong the usefulness of this propeller by forestalling corrosion and pitting which starts deterioration. These propellers being idle for long periods during the dredging of canals and other such work, and subsequently rotating under sandy conditions, become deeply pitted and worn, until they are so weak that they readily bend and break when contacting with solid objects.

In the propeller illustrated, which is of cast steel, the damaged edges were straightened and repaired by welding in properly fitting pieces of similar metal to restore the contour to normal shape. The surface of each blade was then thoroughly cleaned by blasting with sharp angular steel grit under pressure, and while thus cleaned and free from oxidation, a new hard steel material was welded into all of the cavities, restoring the surface to normal thickness.

Following this welding operation the surface was ground by power-operated portable grinders to conform the restored areas to their original shape and thickness. Their final condition

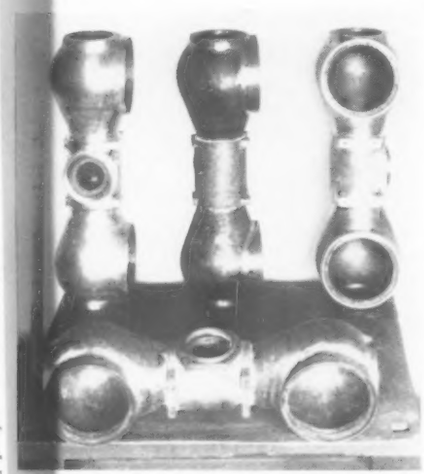


FIG. 4—X-ray tube housings are sprayed with a protective lead coating.

was checked with a suitable pitchometer. A band around the outer edge of each blade, to a radial depth of 10 in., tapering off towards the center of each blade, but including practically all of the surface subject to frictional wear, was then reblasted and sprayed with zinc on two opposite blades. Following this high carbon steel was sprayed on the other two blades to a prescribed depth, coating both sides of each blade.

More Service Life

This application is expected to prolong the life of the propeller and thus decrease maintenance expense to a degree which will justify this undertaking as a sound economic procedure. In the final finish of the operations described, the sprayed surface was properly ground and polished. The whole propeller was checked for pitch and balance in line with the usual requirements covering any such type of repair. This propeller when painted in the usual manner will be installed alongside a similar propeller in good normal condition for contrast and comparison over a long period of service.

There are two advantages anticipated—the applied metal coatings will shield the base metal against deterioration; and secondly, the surface of the base metal in the blades has been reinforced with new welded material.

Figure 2 shows same propeller restored to the described condition with the sprayed areas whitened to indicate the location of this treatment. The metal spray operation in Fig. 3 is being applied to a 13 ft. by 8 in. tailshaft to restore its bearings to normal size and to fill up all the eroded surface in between these bearings. Figure 4 illustrates the application of protective lead coatings to X-Ray tube housings on equipment used by hospitals for cancer treatment.

Bela Ronay's Formula For Stress Calculations

In the January, 1938 issue, pages 24-26, Bela Ronay, senior welding engineer, U. S. Naval Academy Annapolis, Md., described a laboratory method of demonstrating and testing residual stresses in welded joints.

The following data are required to enable the computation of the stress:

a = Width of the cantilever plate

b = Thickness of the cantilever plate

l = Length of the cantilever plate from the center line of the joint to the center line of the hydraulic tube which presses directly on this plate

m = The section modulus of the cantilever plate = $ab^2/6$

P = The load (gage pressure × A)

A = Plunger area

From the above the stress is:

$s = Pl/m$

The deflection observed must correspond to the value of the stress obtained from the above calculation. Therefore, to check the accuracy of the system calculate:

d = deflection

I, moment of inertia of the cantilever plate = $ab^3/12$

E, modulus of elasticity = 30,000,000

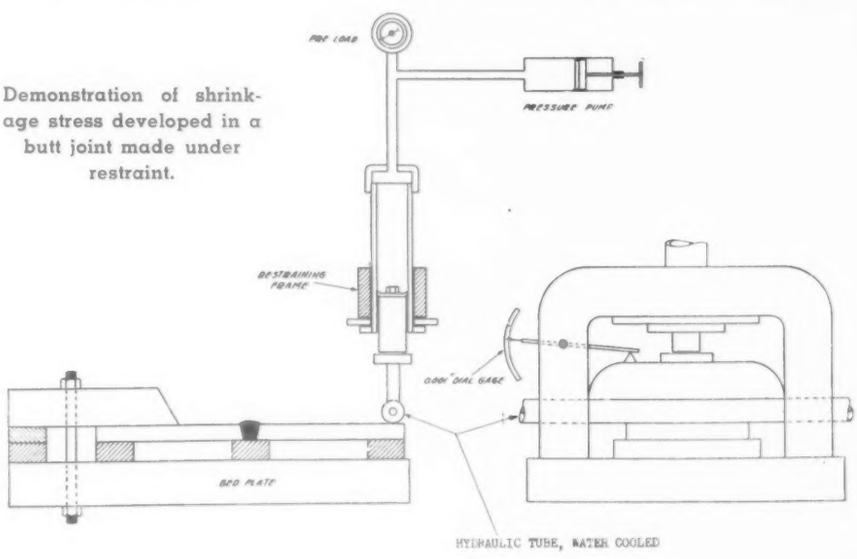
d_o = observed max. deflection

The deflection is computed:

$d = Pl^3/31E$

Then the ratio of d/d_o, or its inverse value as the case may be, is the efficiency of the apparatus. This was found, using a restraining frame proportionate to the dimension of the plate and its overhang, to be better than 95 per cent.

The heavier the plates which are used, the more attention must be paid to the construction of the restraining frame and of the hydraulic press. However, the information obtained in using heavier plates, especially when the interpass temperature is varied from room to 400 deg. F. will prove it definitely that residual stresses may be reduced to negligible values when the assembly to be welded is preheated to a moderate but uniform temperature.



Demonstration of shrinkage stress developed in a butt joint made under restraint.

Machine for arc

Welding Tanks or Cylinders

★ Several unique features incorporated in production tool which can be built at reasonably low cost

By A. M. MacFARLAND

Welding and Production Engineer, Freeport, Ill.

An illustration shows details of a machine adapted to hold a tank or cylinder firmly in position for welding, and to traverse an automatic welding head along the seam. It is designed for economical building, and may be fabricated by the ordinary welding shop, equipped with a small tool room, at a comparatively low cost.

An advantage of the machine is that the edges of the tank are held firmly down against the backing strip. Also, each edge is held separately, while the other is adjusted to give the desired gap. Adjustable speed is provided for the carriage or trolley drive, and the speed will remain constant at the speed for which it is set.

Unique is the means for providing the hold-down pressure, capable of being regulated as desired, from merely enough to hold the edge in position, to a heavy pressure, sufficient to flatten the plate firmly against the backing. Several thousand pounds per lineal foot may be obtained if desired.

Taking into consideration the fact that the main cost of such a machine is generally the cost of patterns, castings and machine work, the designer has fabricated this device from structural steel shapes, largely avoiding machine work and patterns. The stake or supporting element which holds the tank, pipe or cylinder, may be of any desired length to suit the needs of the shop. It may be replaced with a different length stake if desired.

The trolley has a range of welding speed adjustable from a few inches per min. to four or five feet per min. Two or more welding heads, may be mounted on the trolley, if desired, arranged to have one bead follow another, when welding heavy stock.

Trolley Drive

The trolley is driven by means of the friction of one set of wheels on the rail provided by the edge of the I beam *G*. The wheels on the other side are flat and free to adjust themselves to any slight irregularities of pitch in the track. The reel of welding wire, *R* is mounted above the trolley, and its weight helps to give traction to the trolley wheels.

The trolley wheels are carried by stock pillow blocks, obtainable from supply dealers. Also the wheels may be obtained with flat treads and grooved to suit. Electric power is brought in to the trolley by means of a flexible cable, looped from the roof of the shop. The automatic welding head may be of any desired manufacture and is mounted on the trolley as shown at *T*. A nozzle supports and feeds the welding rod *V* to the arc. A guide wheel, *S* guides the rod.

The general requirements for mak ing a good uniform seam weld witho skips or leaks are as follows:

The plate must be held firml against the backing, in order that ther may be no air space under the plat for the arc to burn through, also t provide a continuous electrical contac and avoid "whirls" in the ground cur rent, which may set up irregular mag netic fields, tending to blow the ar about, and expose the hot metal t the air.

The welding speed must be uniform and capable of adjustment to secur the desired fusion and height of bead It should be kept in mind that a var ation of ten per cent in speed, whe welding is the same in effect, as variation of the same amount in weld ing current, and will cause variation in the weld.

Many of the welding machines hav the traverse speed driven by lo powered d-c. motors, and such motor are likely to vary over a wide range following slight changes in the me chanical load, due to changing friction etc. The machine offered is driven b an a-c. motor, which will maintain reasonably constant speed, and th speed regulation is obtained by mean of a pair of vee-belt pulleys, havin adjustable pitch diameters. These ad justable pulleys are a stock article

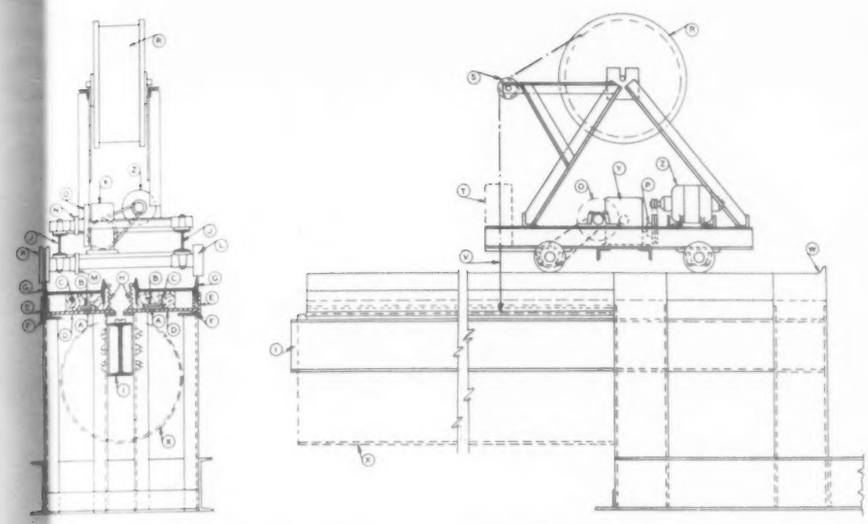


Diagram of seam welding machine for production work on cylindrical tanks.

made by several manufacturers, and having one flange adjustable to shift the diameter of the drive as desired. The motor is mounted on a slide to take up the belt slack. The belt length may be kept uniform by enlarging one pulley as the other is decreased. The main speed reduction is obtained by means of the reduction gear *Y*. The vee-belts *Z* carry the pitch adjustment feature.

Backing Strip

The tank to be welded is slipped over the outer end of the stake *I*, with the seam resting on the backing strip at the top. This backing strip may have a cut-out as shown, to permit the weld to form a slight inside bead, or may be flat, as desired. It may be of copper, or of any suitable metal, adapted to the job. It is removably attached to the stake, by a few bolts or screws.

The holding down power is supplied by the expansion of the rubber fire hose shown at *B* and *B*. This hose is of the type which is normally flat, and may be of 3 or 4 in. in diameter. Air pressure causes it to expand, and force downward the pressure element *D*.

The pressure may be regulated by an air reduction valve. For example, a 4-in. hose, with 50 lbs. of air, will exert an expanding force of about 200 lbs. per linear in. A part of this is taken by the fulcrum at *F* and the larger remaining portion holds down the tank edge. It will be seen that either edge may be held, independently, while the other is being adjusted for gap, by means of two valves for air admission. One end of the hose is closed by a flat clamp, while the other projecting end is connected to a small air inlet pipe. The hose is seated in a recess formed in the wooden filler block *C*, which fills the space in the I beam *G*.

The hold down elements *D*, are strips of cold rolled steel, of the order of 4 in. by 3/8 in., laid side by side. They are tied together at the back end by the half-round steel strip *F*, which acts as a rolling pivot, and at the forward end by the continuous copper holding down strip as shown. The angle shown, supports the rear end of the strips *D*, while the steel strip *E* holds them against upward displacement. The assembled *D* strips are slid into position from one end, and the hold-up springs H attached. Under some conditions, it is better to place these springs in drilled holes back of the flange of the I beam *G*.

The outer end of the stake *I*, is hooked or locked in position to the upper members *G*, by the usual bar and cam arrangement (not shown). The stop *W* prevents the trolley from running off the end of the track. The outer end of the stake *I*, projects slightly, for convenience in resting the end of the tank, when loading.

Thin Plates May Be Welded

With this machine, adapted to hold the tank edge firmly against the backing strip, and to flatten out any minor irregularities in the edge by its great pressure, very thin plate may be welded without danger of burn-through spots. Galvanized iron stock may be welded with phosphor-bronze rod, at speeds as high as six or eight feet per minute, without leaving any spots where the zinc is burned off.

The bronze rod alloys with the zinc, and flows to a thin edge, covering the iron until it meets the zinc. Flat or rounded beads may be formed. The bronze costs more than steel rod, but it has some advantage in speed, and does not destroy the protective coating.

The hold down strip may be a solid strip of copper about 1/4 in. x 3 in., or it may be laminated from thin strips. For example, three strips 1/8 in. x 3 in., riveted together at intervals. This strip should be sufficiently flexible to follow any irregular contours, and hold the plate against the backing strip all along the line. The multiple pressure fingers, *D* provide a flexibility which should be retained by this strip.

Technical Directory

To help our readers in obtaining information regarding welding codes, design data or application problems, we have compiled a list of technical associations which are connected with welding activity in some way or other. We hope that this technical directory will be a valuable reference guide. We suggest that this page be torn out and filed in your desk for easy reference.

American Welding Society
33 West 39th Street
New York, N. Y.

International Acetylene Association
30 East 42nd Street
New York, N. Y.

American Society of Mechanical Engineers
29 West 39th Street
New York, N. Y.

American Institute of Steel Construction
200 Madison Ave.
New York, N. Y.

American Society for Testing Materials
260 So. Broad St.
Philadelphia, Pa.

American Society for Metals
7016 Euclid Avenue
Cleveland, Ohio

American Institute of Electrical Engineers
29 West 39th Street
New York, N. Y.

Electric Welding Section
National Electrical Mfrs. Ass'n.
431 Frick Building
Pittsburgh, Pa.

Compressed Gas Manufacturers' Ass'n.
11 W. 42nd Street
New York, N. Y.

American Iron & Steel Institute
350 Fifth Ave.
New York, N. Y.

Association of American Railroads
Engineering Division
59 E. Van Buren Street
Chicago, Ill.

American Petroleum Institute
50 West 50th Street
New York, N. Y.

American Standards Ass'n.
29 West 39th Street
New York, N. Y.

A spark from a cutting torch fell into a can of paint remover—A flash fire resulted.

Study of industrial fires points out how to prevent

Welding and Cutting Fires

★ Most of these fires result from use of portable apparatus in unsafe locations

By H. E. MAGNUSON

Editor of Publications, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

SEVERAL YEARS AGO, workmen were using a cutting torch on a high overhead conveyor above a large pulpwood pile at a paper mill in Detroit. The small globules of molten metal fell on top of the pile and set fire to the accumulation of dry splinters and pieces of bark under the conveyor. Employees laid two hose lines up on the pile, but the fire worked down between the logs, out of reach, and even though firemen later used 29 hose streams and 4 fire-boat streams, the fire burned for three days, destroyed practically the whole pile, and resulted in a loss of $250,000.

More recently, in an automobile plant, an operator and his helper were using a gas cutting torch on roof trusses. A spark from the torch fell into a pail of inflammable paint remover, producing a flash fire which fatally burned two men and damaged building and contents to the extent of $200,000.

A few months ago, a fire destroyed most of a former New Jersey print works, and though the cause *was not definitely determined*, the fire probably started from sparks from cutting torches which workmen were using to dismantle machinery. Another fire in a trestle on the main line of the New Haven Railroad seriously disrupted traffic for several days last summer; here again *the cause was undetermined*, but workmen were using welding equipment at the time, and an unseen spark *may have* started a smoldering fire in the dry piles and timbers. In still another instance, a spark from a cutting torch used in dismantling old automobiles started a fire which destroyed a large garage and automobile salesroom in Rhode Island. Another typical experience involved two firemen in a Massachusetts city who were using a cutting torch on an empty drum; the torch ignited an explosive mixture of gasoline vapor and air in the drum, the drum exploded, and the men were seriously injured.

Fires Have Increased

These are some of the typical cutting and welding fires. Similar fires are occurring with increasing frequency in manufacturing plants, as reflected by the fire record of the representative group of industrial properties insured in the Factory Mutual Fire Insurance Companies. Since 1921, a total of 78[illegible] cutting and welding fires in these plants have caused losses totaling

$800,000, an average of more than $1,000 a fire. In 1921, only five such fires were reported.

As the advantages of gas and electric cutting and welding became more apparent and its use increased, the fires also increased, reaching 69 in 1929. With curtailed industrial activity and a slump in construction, the fires fell off to 40 in 1933. Since then, they have increased at an alarming rate: 62 in 1934, 71 in 1935, 88 in 1936, and, based on the first six months, an estimated 116 in 1937. This means that at the present time, in this group of 8,500 industrial plants, cutting and welding fires serious enough to be reported are occurring at an average rate of about once every three days.

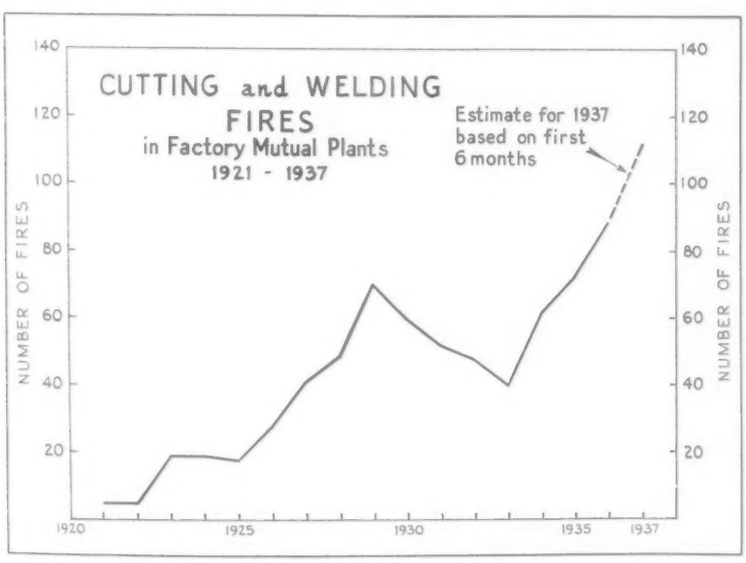
Watch the Flying Sparks

A closer analysis of the last ten years shows that out of a total of 588 fires, 483 involved gas torches and 105 electric welding. Of the fires incident to the use of gas torches, only 68 were due to the heat of the flame or to some failure of the equipment, showing how well the apparatus has been designed and how well instructed the operators generally are in the care and use of the apparatus itself. The other 415 fires involving torches, and the 105 fires incident to electric welding, or 93 per cent of the total, resulted from the *sparks or globules of hot slag* igniting combustible material with which they came in contact. More impressive figures could hardly be obtained to show the need of bringing this hazard to light and of inaugurating careful supervision and safeguards.

A few of the many fires will be sufficient to show the danger of these sparks or globules of hot slag. A workman was using a cutting torch without permission on a duct near a dust collector; sparks from the torch ignited lint and oily deposits, and the resulting fire wrecked the fan and damaged the collector, at a loss of $4,000. In another instance, sparks from a cutting torch set fire to paint deposits in a spray booth; the fire entered the duct, and damaged the booth, duct, and nearby windows, causing a $2,000 loss. In a paper mill, workmen were using a cutting torch during building changes, a spark set fire to a storage of paper in rolls piled eight to ten high, and the resulting loss amounted to $7,000. In still another instance, a spark from an electric welder used to erect a steel framework above the roof set fire to a wooden motor house and hoist tower, causing a $3,000 loss.

Unsafe Locations

Relatively few fires start in permanent welding locations, which are generally safe or can be made so. One of the significant things in most of the reported fires is that they result from the use of *portable* apparatus in locations where it is not safe to use them, or without taking adequate precautions. This includes the use of torches for cutting metal, and either gas or electric welding. Because of the versatility of the equipment, the fires have occurred during such diverse operations as steel erection, machinery and piping installations, tank repairs, repairs to machines or equipment, and the dismantling of buildings, machinery, piping, or fixtures.



During the period covered, the number of insured properties included in this group increased from 3500 to 8500.

The "sparks" are really globules of molten metal. Of the millions of sparks given off, most die immediately; others are of sufficient size to hold heat long enough so that they can roll considerable distances into out-of-the-way places where they can either ignite loose, combustible material at once, or else start smoldering fires which break out hours later. These sparks have ignited material such as lint and oil deposits, paint drippings on drainboards, rubber insulation, burlap bags, paper, loose rags, tarpaulins, and other material with which they have come in contact. They have been known to travel 30 ft. or more and ignite flammable liquids in dip tanks or similar containers or processes. Several dangerous explosions have occurred through the use of torches on empty tanks or drums which still contained sufficient flammable vapors to produce explosive mixtures with air.

Proper Safeguards

Too much emphasis cannot be given the importance of recognizing the danger from cutting or welding sparks. Operators may become so accustomed to the sparks that they cease to recognize them as an insidious fire cause. The problem appears to be one of proper instruction and supervision. Managers of busy manufacturing plants would not be likely to jeopardize important production and the safety of their employees by even the temporary use of any equipment which involves definite fire hazards, unless its use has been properly safeguarded. These fires are readily preventable. The causes are easily understood and the precautions simple to adopt. Foresight in preparation and care in operation are the most important preventatives.

The Lessons of Experience

Because portable cutting or welding equipment can be taken into any part of a plant, the use of it needs careful supervision. A welding superintendent, fire chief, or other capable employee should have full responsibility to decide whether it is safe to use the equipment in any proposed location and what precautions must be taken. A number of large concerns have adopted the excellent practice of requiring permits signed by designated persons before any work can be done. A more general adoption of this practice is suggested. It is very important to prevent the unauthorized use of the equipment by operators who may not

appreciate the danger or may be indifferent to it.

Similar supervision should be given work done by outside contractors, and it may be advisable to include a clause in the contract, permitting cancelling the contract if the work is not being done safely. In a number of instances, contractors have not appreciated the special conditions existing in some plants, with the result that serious fires have occurred through failure to take the precautions which were necessary.

If any cutting or welding is being done during construction changes which also require changing sprinkler piping, it is very important to make sure that the sprinklers are not shut off while the cutting or welding work is in progress, so that full fire protection will be available during this work.

Never Shut Off Sprinklers

Portable cutting or welding equipment should not be used in combustible manufacturing buildings, unless the building is protected by automatic sprinklers, and unless the floors and partitions are tight. Frequently sparks have fallen through cracks or holes in floors or walls, starting unseen fires in stories below or in adjoining rooms. Floors in the vicinity of any contemplated work should be swept clean, and wooden floors should preferably be wet down or covered with sheet metal or some equivalent fire-resistive material. If work is done just outside buildings, care is needed to prevent the sparks from entering windows, doors, or other openings.

Combustible Material

If there is any combustible storage, goods, or equipment in the vicinity, it should be moved at least 35 ft. away before work is started. If the combustible material cannot be moved, asbestos or sheet-metal guards or curtains should be provided to carefully and completely cover the material. If there are any processes in the vicinity exposing combustible fibers or materials, they should be shut down while the cutting or welding work is in progress. Any combustible dust deposits, which can be readily ignited by the molten slag, should be completely removed before work is started.

It should hardly be necessary to caution against using cutting or welding equipment in the vicinity of exposed flammable liquids or combustible vapors or gases. However, fires continue to occur under these conditions. Thorough ventilation is important

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PERMIT TO WELD OR BURN

Date_____ Plant_____

Time Started_____ Finished_____

Building_____

Dept._____ Floor_____

Location on Floor_____

Nature of Job_____

_____

Badge No._____
or
Contractor_____

ALL PRECAUTIONS HAVE BEEN TAKEN TO AVOID ANY POSSIBLE FIRE HAZARD

Signed_____ *Maint. Foreman or Engr.*

Signed_____ *Department Foreman*

Signed_____ *Plant Protection*

(SEE OVER)

Form of permit used by the Chrysler Corp.

wherever flammable liquids or vapors have been present. No cutting or welding work should be done on ducts which may contain combustible deposits without first making sure that the ducts are clean.

Always Be Forearmed

When fires start, they sometimes gain rapid headway. It is therefore important to be ready to extinguish a fire before it develops. For this purpose, extra men with small hose, chemical extinguishers, or fire pails should be stationed wherever portable cutting or welding equipment is being used in temporary locations. These men should be constantly alert to see that sparks or drops of hot metal do not lodge in floor cracks, do not pass through doors, windows, openings, or holes in the floor, or do not pass over or below curtains or guards protecting combustible materials. Out-of-the-way places, like oily machine pits and clothes lockers, have proved to be frequent starting points for fires due to cutting or welding sparks.

After the work is completed, a man should be stationed at the scene of the work for at least a half hour, or he should visit it frequently to make sure that stray sparks have not started smoldering fires. Floors above and below, and near-by or adjoining rooms should also be carefully examined.

The above suggestions refer specifically to the prevention of fires caused by sparks or hot slag. Fires sometimes also occur in the apparatus itself if it is not properly cared for or properly operated. In the care and maintenance of the equipment, it is important to follow the excellent detailed instructions supplied by the manufacturers of the equipment.

Large Diameter Pipe Used on New Oil Line

By far the larger majority of pipe lines constructed in recent years have utilized pipe of small diameter, including 4-in., 6-in. and 8-in. Occasionally lines have been constructed of 10-in. pipe, but rarely has pipe exceeding 12-in. diameter been used in construction of oil pipe lines.

FIG. 1—Making a field weld on 16-in. pipe line.

FIG. 2—Close-up of finished pipe weld

Here are illustrations of one of the largest diameter oil pipe lines ever constructed. This is a new 16-in. diameter line recently completed for the Sinclair Refining Co. in the vicinity of Henrietta, Mo. The line was laid by the Truman-Smith Construction Co. of Eldorado, Kan., utilizing electric welding and equipment supplied by The Lincoln Electric Co., Cleveland, Ohio.

The large diameter pipe was used to provide one single line rather than a number of individual lines which would have been necessary with smaller size pipe. The new line is to replace several smaller lines constructed a number of years ago. Fig. 1 shows an operator welding a joint by the shielded arc process. A finished joint is illustrated in Fig. 2.

Hard-Facing of Pulverizing Hammers Lengthens Service Life

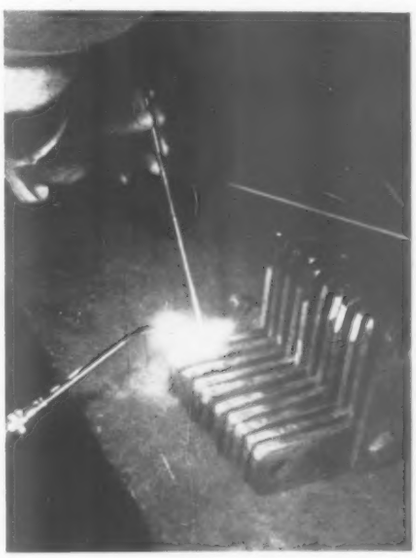
HARD-FACING OF HAMMERS for grinding linseed cake into cattle feed is a welding application in general use. Pulverizing and grinding hammers for crushing many different types of materials, are being successfully faced with hard-surfacing materials. Hog hammers, used on wood in paper mills, are among the outstanding examples. Charcoal pulverizing hammers and alfalfa and grain mill hammers, too, are being hard-faced with successful results.

Depending upon the type of hammer involved, the hard-facing material may be placed on the ends, edges or corners, generally on the front or striking face where it will receive maximum support from the steel backing. However, the welding procedure is the same for each. The hammers are either laid on a brick table, or set in a vise or other fixture for hard-facing. No preheating is necessary, except with the welding flame. Hard-facing material is then flowed on to the proper areas until the hammers are completely built up to the desired size. When the hard-facing operation has been completed, the heat is removed very slowly to prevent the formation of cracks or checks. This is done by cooling under the flame, or by placing the entire hammer in a box of powdered mica, ashes or similar insulating material so that it will cool slowly.

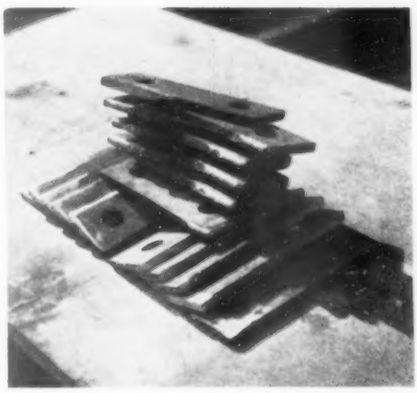
Hammers which have been hard-faced in this way before being put into service can withstand the severe conditions of abrasion encountered during pulverizing and grinding to a much greater degree than can ordinary steel hammers. Several random examples will bear out this statement.

At one paper plant in the South, hog hammers are now cut with the oxy-acetylene blowpipe from grade A structural steel of approximately 0.30 per cent carbon content. The dimensions of each hammer are 8 in. wide by 11 in. long. Holes for anchor bolts are also cut with the blowpipe. Although the high carbon steel hammers formerly used had a cutting edge bevel of approximately 50 deg., it has been found that hard-faced hammers should not have more than a 30 to 35 deg. bevel. Cost records show that where the original plain steel hammers cost $6.00 apiece, the home-made hard-faced hammers can be made up at from $3.50 to $3.75 each. In addition, performance figures have been accumulated to show that hard-faced hammers last 6 to 8 times longer than the steel hammers. As the deposit of hard-facing alloy is from 1/16 to 3/32 in. thick, only approximately one-half pound of hard-facing alloy is required for each hammer.

At a Southern chemical plant, charcoal hammers pulverized approximately 400 tons of charcoal before they were completely worn out. Hard-facing was considered, and it was finally decided to cut the hammers from 5/8 in. steel plate and then, after shaping, to apply Haynes Stellite to the edges and finally drill the holes for mounting and grind the hard-faced ends to size. The hammers were then put into service and records were kept of their performance. They lasted 36 weeks, compared to 6 weeks for unsurfaced hammers, and during this time pulverized approximately 2,400 tons of charcoal before hard-facing became necessary. Since it requires 4 hr. to change the hammers and the mill must be shut down whenever this is done, hard-facing has proved to be definitely profitable.



Applying Haynes Stellite to a mill hammer.



Hard-surfacing these charcoal mill hammers lengthened their lives 6 times.

The alfalfa mill hammers at an Arkansas plantation are 2 in. wide, 3/8 in. thick and 5 in. long. Twenty-two of these are mounted together to form a set. The inner hammers were hard-faced across the 2 in. edges and about 1 in. along the narrow 5 in. side, beginning at the corners. However, because of the more extreme abrasion encountered by the four end hammers, these were hard-faced all around the working ends. Formerly, steel hammers lasted approximately 1 week. Now, however, each set of hammers lasts from 6 to 8 weeks per corner, lengthening the life of each set (including all four corners) to 6 months as compared to 1 month formerly.

Another report states that Haynes Stellited hammers at a cottonseed oil company run 30 days under the same conditions where the average life of regular steel equipment was 4 days. Hard-faced hammers are standard at this plant.

In all of these cases the base metal, of which the hammers were made, was medium carbon steel. A 0.30 to 0.50 per cent carbon steel is considered excellent for this purpose. Lower carbon steel may mushroom under impact, while higher carbon steel may become slightly brittle from the welding heat and later crack in service.

Because of the success of these many applications, many other mills have now standardized on the hard-facing process for hammer upkeep. Not only does hard-facing decrease the material cost, but the rebuilt parts last so many times longer than the original steel parts, that shutdowns and time out for replacements are minimized. Hard-facing has thus proved to be a most efficient and profitable process in the maintenance of crushing and grinding equipment.

Earthquake-proof Welding Shop

"More than just a name" is the slogan used in promoting the welding service of E. L. White, owner of the Elco Welding Works, Maywood, Calif. Mr. White recently completed his new shop, which has a 70 ft. front and a depth of 50 ft. The doors have a 14 ft. clearance. The floor is made of heavy reinforced concrete to withstand big jobs, large loaded trucks, etc.

The walls are a combination of brick and concrete heavily reinforced throughout with welded steel. It is claimed that the structure is positively earthquake proof. A well equipped office and a storage room for tools, parts, etc., are situated at the left end of the building shown herewith.

Mr. White specializes in the construction of truck tanks and in fish plating (reinforcing) trucks used in the transportation of petroleum products. In California most trucks, even of small capacity, owing to good roads and favorable weather conditions, are sooner or later subjected to overloading. In order to comply with the state highway laws, these trucks must be reinforced for this heavier service. These "reconditioning jobs," or "conversions," bring obsolete tanks and trucks up to the required specifications.

This welding shop is housed in a substantial fireproof and earthquake-proof building.

Grand Stand Utilizes Second-Hand Pipe

One of the first instances in which second-hand pipe has been used in the framework of a building, was the erection of a ball park grandstand recently completed at Monroe, La. The erection of the stand was accomplished in 30 days by using the electric arc process of welding.

This new grandstand, which is shown completed, was designed, engineered and constructed by the Brown Paper Mill Co. of West Monroe, La. The ability to use second-hand pipe as the steel frame for the stand, which was made possible by welding, accounted not only for the fast erection, but permitted construction of the stand at great savings in material costs.

Pipe of 2 in., 3 in., 6 in. and 8 in. diameter was used. The 6 in. and 8 in. pipe was used as columns. The roof of the stand is of 4 in. channel iron, welded integral with the pipe-supporting frame work.

Reference to the illustration will show details of the frame work utilizing the 6 in. and 8 in. diameter pipes. The main columns supporting the trusses are 8 in. The trusses themselves are composed of top and bottom chords of 6 in. pipe with cross lateral bracing composed of 6 in. and 3 in. pipe. The seats of the stand are supported by 2 in. and 3 in. diameter pipe joined together by electric welding into a series of frames. In order to provide a surface for the wooden plank used for seats, pieces of angles were cut and welded to the seating support.

The erection of this grandstand was done with welding equipment supplied by The Lincoln Electric Company, Cleveland, O.

Grandstand built of welded second-hand pipe.

Welded Disposal Burners

A rather interesting job of tank welding was completed some time ago by the Southwest Welding & Mfg. Co. of Alhambra, Calif. The work comprised the construction of a battery of sewer gas and fumes disposal burners or tanks, for the city of Pasadena.

Particular care had to be exercised in welding these tanks, and reinforcing them at all seams by the use of

Pair of arc-welded tanks are 18 ft. high, 16 ft. in diameter of 3/8 in. boiler plate.

in. angle irons. This was necessary in order to control the expansion and contraction of the tanks while under the extreme heat to which they would be subjected when in use. Made of ⅜-in. boiler plate, the tanks are 18 ft. high and approximately 16 ft. in diameter at the base. They were arc welded and field fabricated.

The tanks are lined with fire brick and are designed to burn natural gas, at 1,500 deg. F. The two tanks are connected, as shown in the illustration, by a 42-in. section of pipe, cut and fitted with the oxy-acetylene torch and arc welded both inside and out. The angle iron reinforcing at the seams is inside and cannot be seen.

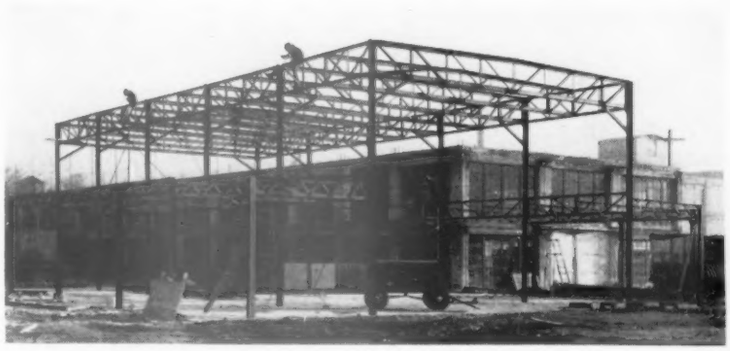
Welding Perfects The "Swamp-Stick"

Short lengths of pipe form the universal extension for wrench handles to give increased leverage, but the ordinary pipe is apt to pull egg-shaped at the end, or even to split under strain, forming a hazard which can easily result in injury to the workman, either through a cut on the sharp edge of metal, or through the loss of hold between wrench handle and distorted pipe.

One pipeline company keeps a set of short lengths of pipe as part of the station tool equipment, having first strengthened the pipe by having the welder run a heavy bead around each end. This bead at the end, subjected to greatest strain, gives the necessary additional stiffness to withstand the load. Another bead on the other end affords a shoulder over which even greasy hands can not fail to hold.

Since the adoption of the bead-reinforced "swamp-sticks" as standard, there has not been a single accident attributable to slipping tools. Provision of adequate wrench extensions has cut down on wrench replacements, through an unexpected saving in tools formerly hammered out of shape by men who hesitated to use a risky pipe handle extension.

A "swamp-stick" split under strain is compared with one reinforced by welding a bead at the end, thus strengthening the extension at its weakest point.



Light-weight welded steel trusses have necessary strength to permit operation of heavy-duty hoists.

Welded Steel Factory Construction

The recently revised building code of the cities of New York and Chicago, which permits welding of structural steel, will no doubt accelerate, to a marked degree, this type of construction. It may, therefore, be of advantage to point out some of the reasons, and in what situations welded steel framing is best.

The outstanding reason for welding is, of course, savings in cost of assembly and erection. In the steel building shown here, recently erected for Hobart Brothers of Troy, Ohio, an estimated labor saving of 50 per cent was effected in the shop assembly of steel trusses, and 20 per cent in labor erection costs.

In this particular instance, high overhead strength was essential to permit operation of heavy duty hoists. Due to the ease of welding and assembling light structural members into trusses, maximum strength was obtained with a minimum use of metal. As a consequence, savings were made in the amount of metal used.

Large savings are not unusual in welded steel buildings, and it is expected this will be more generally realized in the near future.

New Shovel Has Welded Boom and Dipper Stick

A new crawler shovel, equipped with new all-welded boom and dipper stick, has recently been designed and built

Welded shovel possesses greater strength with 10 per cent less weight.

by Link Belt Co., Chicago, for strip mining of coal. The boom is 36 ft. long, the stick 28 ft. long. This shovel has a greater reach than the former designs with 35 ft. boom and 21 ft. stick. The bottom end of the boom is flared so as to eliminate "hog rods" and afford greater stability and strength. In spite of this greater strength and size at the bottom of the boom, the welded design weighs 10 per cent less than the old riveted design. It is said to be twice as strong and costs approximately 20 per cent less. The welded design has also permitted the use of a larger sheave (48 in. in diameter) because of the greater strength and rigidity at the sheave end of the boom. The welding was done with shielded arc equipment supplied by The Lincoln Electric Co., Cleveland, Ohio.

Welded Pipe Fittings Simplified By Templates

Welding big pipe jobs is easy if you know how, according to Frank T. Tanner, 736 Folsom St., San Francisco, Calif. "Knowing how," he says, "means following simple rules and practices, systematizing shop practices that permit any one man to take up a job where another leaves off.

FIG. 1—Split-tee pipe unit welded of 10-in. pipe for refinery service.

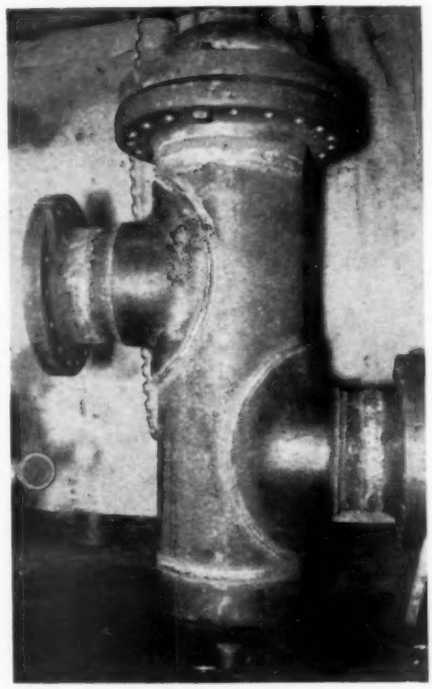


FIG. 2—Welded 16-in. pipe with 12-in. nozzles, using one method of flange reinforcement to give added strength.

A good example is a rush order for a unit for the dewaxing department of a Bakersfield oil refinery. This was a 10-in. pipe job, the tops of the split unit being exactly 30 deg. apart. (See Fig. 1): The blue-prints called for four reinforcing rings at the joint, the stock used being ¾ by 5-in. plate. Variations of a fraction of an inch wouldn't pass on this exacting unit.

Mr. Tanner took the blue-prints, prepared templates to actual size, allowed for expansion and contraction —and two men, after 18 hours welding, completed this 1,800-lb., 8-ft. Y. Time included the layout, marking and cutting the angle, the welding and application of the Series 600 flanges shown, as well as the final finish. This weld was for a 900-lb. pressure line and had to stand up under an exacting test. The pipe was an extra heavy grade. The two small jobs at the base of the Y are shown merely for comparison.

Figure 2 shows a 16-in. pipe with 12-in. outlets for high pressure lines. The picture gives a close-up of the flange and removable dome. Removal of the dome permits the application of screen strained packing.

Figure 3 shows some of the big steam line fittings used in the new Atlas Glass plant in Oakland, Calif. The husky welder in the background gives some idea of the types of jobs handled in this shop. At the right is a 16-in. pipe, with two lateral outlets of 8 in. further reduced to four 4-in. outlets. Each outlet had to be in its exact location. Blue-prints would allow no variations. By making exact-sized paper templates, wrapping them about the pipe, soapstone markings, and cutting and welding to the line, the jobs came out to specification and "on the line."

Mr. Tanner, or any of his welders, can pick up a job at any point and carry on with it. His plan of operation is so developed that the work is simplified. Part of his experience dates back to army days, when as a youth his welding experience placed him in charge of a unit in the Air Service.

FIG. 3—By using paper templates, and soapstone markings, these jobs were completed exactly as indicated on the blue-prints

News of the Industry

K. L. HANSEN, consulting engineer for the Harnischfeger Corp. of Milwaukee and inventor of the Smootharc welding generator, presented a paper "Interpretation of Oscillograms of Arc Welding Generators in Terms of Welding Performance," at the A.I.E.E. winter convention in New York City, January 24-28. Mr. Hansen is working for the development and adoption of definite welding standards. He based his discussion on the fact that one of the most important features of the arc welding generator is its ability to respond quickly to rapid variations in voltage and amperage.

C. G. M. A. CELEBRATES 25TH ANNIVERSARY

The Compressed Gas Manufacturers Association held its 25th annual convention at the Waldorf-Astoria Hotel, New York City, on January 17-18. The convention was preceded by a series of technical committee meetings, but officially opened with a luncheon on January 17. W. J. WILLENBERG, who has had considerable experience with the use of hydrogen in many applications, including its use in lighter-than-air craft, delivered an informal talk reviewing the circumstances leading up to the Hindenburg disaster.

The Association's annual business meeting was held during the afternoon of January 17th. At that meeting the members of the Association received reports from their officers and from the many technical committees responsible for the greatest part of the Association's activity. It also voted minor amendments in its by-laws and elected officers for the year 1938, as follows:

JOHN J. CROWE, president.

P. F. LAVEDAN, vice-president.

F. C. ZEISBERG, vice-president.

F. R. FETHERSTON, secretary-treasurer.

The entire day, January 18th, was devoted to the presentation of a series of papers on subjects of interest to the industry. The speaker at Tuesday's luncheon was Herbert Wilson Smith, who delivered an excellent talk on general business conditions. In the evening of January 18th the twenty-fifth annual banquet fittingly terminated the "Silver Anniversary" celebration of the Association. John Motley Morehead, former U. S. Minister to Sweden, was the toastmaster and addresses were delivered by Judge Isaac Nelson Meekins, of the U. S. District Court, and E. M. Allen, president of the Mathieson Alkali Works, Inc. About 300 members of the industry were present at the banquet, including a large delegation of Canadian manufacturers.

LINCOLN ANNOUNCES NEW SLIDE FILMS ON WELDING

The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, sponsor of the $200,000 award program, announces that it has prepared a series of slide films portraying the application of electric welding to various products and structures. These slides have been prepared for educational purposes and are a part of the Foundation's plan to encourage scientific progress of the arc welding industry.

The films are being made available for showing by engineering societies, both national and local chapters, junior sections, technical clubs, trade schools, engineering colleges and universities and any other groups desiring to make use of them. The first film is currently available and a projection print, together with a mimeographed copy of the accompanying text matter, can be obtained by societies, etc., if they will write the Foundation, P. O. Box 5728, Cleveland, Ohio.

The films are made up on 35-mm. reels, each one containing between 40 and 50 individual illustrations. Arranged for reading in conjunction with the films, is a typewritten explanation discussing the subject in practical language, while giving a thorough description of the particular subject under discussion.

The first in the series of slide films is entitled "Arc Welded Construction of an Industrial Building Which Ignores Roof Trusses." The design of the building, which has attracted considerable attention, is pictured in 41 individual illustrations. Its construction and essential details are described in the text which is keyed to the film. The revolutionary feature of this building is the complete absence of any intervening framework from floor to ceiling, made possible by the substitution of welded rigid frames for conventional truss framing.

Other subjects covered by the present series of slide films include: The Shielded Arc Process of Electric Welding; Changing from Cast to Welded Steel Construction; Arc Welding Applied to Structural Work; Construction of Oil, Gas, and Water Pipe Lines by Electric Welding; Surfacing; and Automatic Welding. Other subjects of particular interest will be covered in later slide films.

IN CONTRAST WITH THE POLICY of some companies in reducing their sales forces, Manning, Maxwell & Moore, Inc., Bridgeport, Conn., manufacturers of valves, gauges, safety valves and control instruments for industrial plants, announce an increase in their general field organization of 25 per cent. Nine new general salesmen completed their factory training and were assigned territories February 1st. This increase in the sales force will permit smaller territories and more complete coverage. In periods of retarded buying more calls must be made in order to maintain the same sales volume. "Our enlarged sales force will enable us to call on more new prospects and our present ones more frequently," stated the sales manager.

HOTTER THAN THE SUN'S SURFACE

Natural-color motion pictures made with a high-speed camera (1,000 frames per second, with exposures of 1/10,000 second) of arcs being struck in different gases were shown for the first time recently by Dr. C. G. Suits of the General Electric research laboratory at a dinner of the Eta Kappa Nu, honorary electrical engineering society in New York City, January 28th. To the eye such arcs were simply explosive, spattering, intensely brilliant sparks; as slowed down and enlarged by the camera they were revealed as brilliantly colored flames, slowly pushing out tiny, brilliantly flashing globules of molten metal, and wandering rather gracefully around the edges of the electrodes for a brief interval before becoming more or less stable at the electrode tips.

Flames of different colors were revealed by different gases and, in the case of oxygen, the fire was a conglomeration of a multitude of hues. The film also included views showing the arcs being blown sideways into graceful curves upon holding small but powerful Alnico magnets near them. Each of the sequences required more than a minute for showing; actually the action had been completed in less than a second.

"It has been said that electric machinery consists of copper, iron, insulation, and arcs; and the part we know the least about is the arc," said the speaker. Dr. Suits has published scientific papers describing how the extremely high temperatures of electric arcs can be measured accurately by photographing sound waves as they pass through the conducting discharge column of an arc. Temperatures in excess of 11,000 deg. F., above that of the surface of the sun, have been measured by him at the core of arcs, employing the sound-wave method.

At such high temperatures, gases which at ordinary temperatures have molecules containing two atoms are broken down into single atoms, with decidedly different properties. An application of this effect has been made in connection with atomic hydrogen arc welding, as developed a few years ago by Dr. Irving Langmuir of the same laboratory.

C. H. Jennings Reports on European Welding Practice

"Welding in Europe has grown to be as important a tool in engineering as it is in the United States," according to Charles H. Jennings, Research Department, Westinghouse Electric & Mfg. Co., who has recently returned from Europe, where he spent six months as consultant for the English Electric Co.

Speaking before a meeting of the Pittsburgh Section, A. W. S., Mr. Jennings stated: "To draw definite conclusions as to the state of advancement of the welding art in different countries is difficult. Certain industries are somewhat backward, the same as they are in the United States. Other industries can match their work and welding processes with the best in the United States. The production of resistance welded tubing in England at the rate of 65 ft. a minute and the use of welding manipulators in Holland to rotate a complete railway coach to facilitate

CHARLES H. JENNINGS

down-hand welding are examples of developments that will match the best in America."

Welding machines in Europe are of high quality and in most countries the use of a-c. equipment far surpasses the use of d-c. equipment, Mr. Jennings stated. Special attention has been directed to low rating machines for thin guage welding, with the consequence that excellent a-c. and rectifier type sets have been developed for this work.

Welding electrodes in Europe are primarily of the shielded-arc type although considerable bare and light-dipped electrodes are still in use in Germany and France. There are many more makes of electrodes in Europe than there are in America, but the best electrodes do not seem to compare in quality or performance to those manufactured in the United States.

Spot and other types of resistance welding are not in common use as they are in America. There is a great interest in this method of welding, however, particularly for automobile, aircraft and railway construction. Auto manufacturers are at the present time considering the installation of equipment of special types for the production of duraluminum bodies. Gas welding, cutting and brazing are in use and very good results are being obtained on all types of metals. Fabricated parts made from 1-in. aluminum have been welded.

The industries in which welding is being extensively used compare with those in the United States, concluded Mr. Jennings. Ships, buildings, bridges, railway coaches, autos, busses, elevators, pressure vessels and all types of engineering equipment are being fabricated by welding.

H. O. T. Ridlon, well known welding columnist and good will ambassador, addressed a group of welding students on the evening of January 27th, at the International Trades Institute, 741 West 70th St., Chicago, Ill. Our reporter informs us that H. O. T.'s subject was "What the Future Offers to the Welder."

Tenth Welding Conference

Iowa State College, Ames, Iowa

Program of the tenth welding conference at Iowa State College, Ames, Iowa, is practically completed:

Tuesday, March 22nd

8:00 a.m.
- Registration, Engineering Hall and Exhibit Hall.

9:00 a.m.
- Exhibits and Demonstrations, Exhibit Hall.

1:00 p.m.
- Room 207, Engineering Hall.
- Modern Metal Working with the Oxy-acetylene Flame, Motion Picture by U. S. Bureau of Mines.
- Oxy-acetylene Cutting in Fabrication, F. C. Hutchison, Linde Air Products Co.
- Welding Copper and Copper Alloys, W. C. Swift, American Brass Co.
- Welders Round Table — Oxy-acetylene Welding and Cutting, Discussion Leader, L. C. Monroe, *The Welding Engineer*.

4:00 p.m.
- Demonstrations, Exhibit Hall.

Wednesday, March 23rd

9:00 a.m.
- Demonstrations, Exhibit Hall.

1:00 p.m.
- Room 207, Engineering Hall.
- Arc Welding from the Operator's Standpoint, H. C. Kelsey, Machinery and Welder Corp.
- New Uses for Equipment in the Job Welding Shop, L. O. Schneiderwind, Omaha Welding Co.
- What the Operator Learns by Testing Welds, H. L. Daasch, Mech. Engr. Dept., I.S.C.
- Welders Round Table—Hard Facing, Discussion leader, L. C. Monroe.

4:00 p.m.
- Demonstrations, Exhibit Hall.

6:30 p.m.
- Welders' Banquet, Under direction of Mayor W. L. Allan. H. C. Boardman, Chicago Bridge and Iron Co., Div. Vice Pres. American Welding Society will speak on, "Field Welded Tanks."

Thursday, March 24th

9:00 a.m.
- Room 207, Engineering Hall.
- Arc Welding, Natural Color Motion Pictures, General Electric Co.
- Flame Hardening and Softening, Air Reduction Sales Co.
- Welding in Production and Construction, A. T. Cox, Jr., Lincoln Electric Co.
- Welders Round Table—Arc Welding, Discussion leader, L. C. Monroe.

1:00 p.m.
- Demonstrations, Exhibit Hall.

Ohio State University Welding Conference

All exhibits of the conference in Columbus, Ohio, will be located in the Industrial Engineering building, on Woodruff Ave., directly east of the radio towers. The technical sessions and the testing of a full size welded truss will be held on the second floor of the Engineering Experiment Station, which is also on Woodruff Ave., directly east of the Industrial Engineering building. Everyone attending the conference, including students, is requested to register at the Industrial Engineering building immediately upon arrival.

A full size welded steel truss, furnished through courtesy of Truscon Steel Co., will be tested to destruction as a part of the program on the afternoon of February 25th. All exhibits in the Industrial Engineering building will be dynamic in nature.

Technical Program

Thursday, February 24th, 1938

9:00 a.m.

Exhibits and Demonstrations.

1:30 p.m.

Address of Welcome.

George W. Rightmire, President, The Ohio State University.

Short Talks.

C. E. MacQuigg, Dean, College of Engineering.

John Younger, Chairman, Department of Industrial Engineering.

The Modern Welding Formula and How It Works.

H. S. Card, Development Director, National Electrical Manufacturers Association.

7:00 p.m.

Exhibits and Demonstrations.

Meeting of Columbus Section of American Welding Society in Room 200, Industrial Engineering building.

Friday, February 25th, 1938

10:00 a.m.

The Story of Stainless Steel.

T. R. Lichtenwalter, Republic Steel Corp.

1:00 p.m.

The Introduction of Welding in Highway Bridge Construction.

H. H. Hawley, Bridge Engineer, Ohio Department of Highways.

Welding Rod Coatings.

D. J. Demorest, Chairman, Department of Metallurgy, The Ohio State University.

Testing to Destruction of a Full-Sized Welded Truss.

H. J. Hoffman, Engineering Experiment Station, and R. D. Kirkwood, Manager, Columbus Office, Truscon Steel Co.

Meetings

FEBRUARY 21, 1938

Western Society of Engineers, 205 W. Wacker Drive, Chicago, Ill.
"Chicago Building Code", by V. O. McClurg, chief structural engineer, Holabird & Root, Chicago.

FEBRUARY 24-25, 1938

Ohio State University, Columbus, Ohio.
"Seventh Annual Welding Conference" in the Industrial Engineering building. O. D. Rickly in charge.

MARCH 2-4, 1938

Omaha Welding Co., 1501 Jackson St., Omaha, Nebr.
Sponsoring a welding conference for users of welding processes in Omaha area.

MARCH 7-11, 1938

American Society For Testing Materials, 260 So. Broad St., Philadelphia, Pa.
"Annual Committee Week", Seneca Hotel, Rochester, N. Y.

MARCH 14-17, 1938

National Railway Appliance Association. Annual equipment exhibit held in conjunction with annual meeting of American Railway Engineering Association.
International Amphitheatre, Stock Yards, Chicago, Ill.

MARCH 21-25, 1938

Western Metals Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif. In conjunction with Pacific Coast Sections of American Welding Society and American Society For Metals. Meetings of A. W. S. will be held at Biltmore Hotel.

MARCH 22-24, 1938

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.
"Annual Welding Conference"—Program and arrangements are being handled by D. C. Faber, director of engineering extension service.

MAY 14-21, 1938

International Petroleum Exposition & Congress, Exposition Grounds, Tulsa, Okla.

MAY 31-JUNE 2, 1938

Heating, Piping and Air Conditioning Contractors National Association, 1250 Sixth Ave., New York City.
Annual Convention (49th)—Boston, Mass.

JUNE 20-22, 1938

Society of Chemical Industry, 305 Washington St., Brooklyn, N. Y.
Annual meeting in Ottawa, Ont.

JUNE 27-JULY 1, 1938

American Society For Testing Materials, 260 So. Broad St., Philadelphia, Pa.
Annual meeting at Chalfonte-Haddon Hall, Atlantic City, N. J.

Acetylene is a plant stimulator. At the University of Hawaii, Honolulu, the discovery has been made that a mixture of acetylene with air, or a saturated solution of acetylene in water, will stimulate the pineapple plant to root at unexpected places and will also cause the plant to put out flower-producing processes instead of foliage. Plants can be induced to flower a year earlier than normal by this treatment but size of resulting fruit depends on size of the plant. Many other plants respond in much the same way.

More Resistance Welders in Detroit Area

There has recently been installed in the Great Lakes Steel plant at Ecorse, Mich., one of the largest flash welding units ever built. This is the first installation of equipment of this new design, which is a further development of a similar machine which was installed in the Inland Steel Plant at Chicago about a year ago.

This new unit is a Thomson-Gibb machine in the continuous pickling and annealing line. It is used to weld coils of strip steel as they come from the hot mills, and permits the strip to be carried through the pickle line continuously. This arrangement also makes possible a coil of any desired length. Thus a producer of sheet metal parts can get strip steel in any length up to 50,000 ft.

Another interesting installation recently made by Thomson-Gibb Electric Welding Co. in the Herron-Zimmers Moulding Co. plant is a welding unit on which two welding heads are used, each operating independently of the other. This scheme makes the use of a single 150-kva. transformer quite feasible and practically no time is lost in making the welds. The machine is completely automatic, it being necessary only for the operator to load the die and remove the assembly after each cycle. This job is built on the frame of a standard No. 2 welding press. The part to be welded must be securely attached.

Another recent installation at the Herron-Zimmers plant is a duplex welding unit, practically duplicating one installed about a year ago. In this new unit two standard No. 2 presses are used, placing them face to face. A special work holding fixture keeps the three pieces which make the assembly

in very accurate alignment. Four groups of projection welds and two groups of spot welds are made during each machine cycle. This, too, is a completely automatic arrangement, two operators turning out an amazingly large production of rear window frames for one of the medium priced cars.

A. W. S. Activities

CLEVELAND SECTION A. W. S. is sponsoring a series of six lectures in its educational course, "Fundamental Metallurgy—An Outline of Metal Science for Welders," given by HARRY B. PULSIFER, metallurgist, American Steel & Wire Co., Cleveland. Lectures are being held in the Bingham building, Case School of Applied Science, Wednesday evenings at 8 p. m., February 2nd, 16th, and 23rd, March 2nd, 16th, and 23rd. The course is for members of the American Welding Society. EVERETT R. BENEDICT is chairman of the Cleveland Section. Further information can be obtained by writing to American Welding Society, 2261 East 14th St., Cleveland, Ohio.

CLEVELAND SECTION, A. W. S., at its meeting February 9th at the Cleveland Club listened to ERIC R. SEABLOOM, engineer, research testing laboratories, Crane Company, Chicago. Mr. Seabloom's subject was "Welding In The Piping Industry," which he covered with the aid of numerous lantern slides to illustrate the various types of piping connections, reinforcements, etc., employed in high-pressure work.

CHICAGO SECTION, A. W. S., on January 21, 1938, held a joint meeting with the Western Society of Engineers, A. S. M. E. and A. S. M. DR. J. C. HODGE, chief metallurgist of Babcock & Wilcox Co., Barberton, Ohio, presented a welding paper to more than 300 engineers assembled in the Western Society rooms. Dr. Hodge discussed the fundamentals of fusion welding as applied to boilers and pressure vessels. He reviewed welding processes, design problems, types of steels and their weldability, methods of testing welded structures and stress-relieving treatments. A movie film on "Flash Butt-Welding of Rails" was also shown.

DETROIT SECTION, A. W. S., at its meeting on January 28th, held at the Detroit-Leland Hotel, listened to HAROLD JOHN SHEPPARD discuss "Flame Hardening with the Oxy-Acetylene Flame." Mr. Sheppard is chief chemist of Kelsey-Hayes Wheel Co. The paper was illustrated with lantern slides and colored movie films. As an added feature, the movie film prepared by the U. S. Bureau of Mines entitled, "Modern Metal Working With The Oxy-Acetylene Flame" was shown.

NEW YORK SECTION, A.W.S.—"Welded Construction of Some Recent Buildings," by ALBERT S. LOW, vice-president and chief engineer, The Austin Company, Cleveland, Ohio, was presented at the February 8th meeting. The program, of particular interest due to the new provision in the New York building code permitting welding, was arranged by MILTON MALE, U. S. Steel Corp., secretary of the New York Section. "Safety" will be the subject of the March meeting.

PHILADELPHIA SECTION, A. W. S., at its meeting January 17th had an opportunity to hear J. F. LINCOLN, president of The Lincoln Electric Co., Cleveland, Ohio, talk on the subject of electric welding progress. The Philadelphia Section program indicates that the subject of discussion at the meeting February 21st will be "The Use of Castings in Heavy Welding Assemblies." GEORGE A. JESSOP, of S. Morgan Smith Co., York, Pa., will be the speaker.

PITTSBURGH SECTION, A. W. S., at its meeting on January 19th, at the Roosevelt Hotel, Pittsburgh, listened to a talk by CHARLES H. JENNINGS, research engineer of Westinghouse. Mr. Jennings reviewed European welding developments based on his three months' visit as consulting engineer for English Electric Co., Stafford, England. A digest of Mr. Jennings' talk is published elsewhere in these columns.

At its meeting on February 16th, Pittsburgh Section members listened to a talk on "Assembly Plant for Welding of Barges," presented by GEO. F. WOLFE of Dravo Corp., Pittsburgh.

SAN FRANCISCO SECTION, A. W. S.—The San Francisco Section held its first meeting of 1938 on Friday evening, January 28th, at the Engineer's Club, 206 Sansome St., San Francisco. The session followed the usual 6:30 dinner, and had as its principal topic a broad discussion of the subject of welding, which was ably given by J. F. LINCOLN, president of Lincoln Electric Co., Cleveland, Ohio.

In addition to a most interesting talk, Mr. Lincoln also answered many questions of a practical and technical nature and dealing with many current problems. Following Mr. Lincoln's talk the meeting was opened for a general discussion of current welding problems. Chairman N. F. WARD presided.

LOS ANGELES SECTION, A. W. S.—"How Metals Fail," was the subject of an interesting talk given at the January meeting by Professor HOWARD CLAP, chairman of the American Society of Mechanical Engineers and Professor of Mechanical Engineering at California Institute of Technology, Pasadena. The meeting followed the usual 6:30 dinner, and was held at the Central Mfg. District Club Rooms, 4814 Loma Vista Ave. Chairman WAYNE HOWARD presided.

"Regulatory Welding Codes" was the subject discussed by the second speaker of the evening, C. E. MCGINNIS, general manager of the Board of Mechanical Engineers, City of Los Angeles. Another feature of the evening was a sound motion picture presented through courtesy of Columbia Steel Co., covering phases of the construction work on the San Francisco-Oakland Bay bridge.

A concluding feature of the meeting was the report of the Nominating Committee. Those nominated to serve as officers of the Section for the ensuing year were:

Chairman: P. D. MCELFISH, materials engineer for the Standard Oil Co. of California.

Vice-chairman: C. P. SANDER, superintendent, Western Pipe and Steel Corp.

Secretary: J. C. GOWING, of the J. C. Gowing Co.

Nominations for the Executive Committee were:

C. M. ALLEN, junior electrical engineer, Los Angeles Bureau of Power and Light.

LLOYD EARL, superintendent, Consolidated Steel Corp.

C. W. ROBERTS, superintendent, Southwestern Engineering Corp.

$2,000 replacement cost

Saved by Tobin Bronze!

2 cracked Diesel engine heads repaired "like new" in short time and at small expense

Water jacket repair is shown above

Valve port was welded as shown here

HERE is how one pound of Tobin Bronze in less than two hours saved $2,000 and weeks of delay. Cracks in these two Diesel engine heads developed—one on the outside of the water jacket and the other on the inside of a valve port.

A welding operation with one pound of Tobin Bronze and 28 feet each of oxygen and acetylene did the job. In less than two hours, these four hundred pound castings were repaired. After the valve seats were ground, the heads were put back in service. *New heads would have cost $1,000 each and would have meant weeks of delay because the castings were made abroad.*

This is another of many instances where Tobin Bronze welding has saved money and time for plant owners. It confirms the verdict of experienced welders that Tobin Bronze is a *better* welding rod.

Tobin Bronze carries the trademark "Tobin Bronze Reg. U.S. Pat. Off." on each rod. Look for it. Be sure you are getting the genuine Tobin Bronze. 87357

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GUY MORRILL, manager, Midwest Pipe & Supply Co.

H. L. NEWBY, superintendent, American Pipe and Steel Corp.

WAYNE A. HOWARD, retiring chairman, Los Angeles Section and Inspection Supervisor for General Petroleum Corp.

SAN JOAQUIN VALLEY SECTION, A. W. S.—The Eagles' Club Rooms, at 1714 "G" St., Bakersfield, Calif., was the place of the January 27th meeting of the San Joaquin Section.

J. C. GOWING, secretary of the Los Angeles Section, outlined that Section's program and proposed participation in the Regional Conference to be held in Los Angeles, March 21st to 25th. This conference will be under the joint sponsorship of the Western Metals Congress, American Society of Mechanical Engineers, American Society for Metals, and twelve other national engineering societies.

Following Mr. Gowing's talk, C. E. DELONG, service engineer for Air Reduction Sales Co., gave a brief, but interesting, talk on the value of the Society's membership and the growth of new Sections. The third speaker of the evening was FRANK LONGO, past-chairman of the Los Angeles Section and welding supervisor for the Southern Pacific Railroad shops in Los Angeles. He gave an excellent talk on the subject, "Railroad Welding Problems."

Announcement has just been received of the names of the officers and members of the Executive Committee of this newly-organized Section. They are:

Chairman: B. RINTOUL, general manager, Western Water Co., Taft, Calif.

Vice-Chairman: J. W. STEEN, welding shop foreman, Standard Oil Co. of Calif., Taft, Calif.

Secretary: H. S. NIX, instructor, Department of Vocational Education, Taft Junior College, Taft, Calif.

Treasurer: I. K. VANDAM, Instruction Dept. of Vocational Education, Kern County Union High School, Bakersfield, Calif.

Executive Committee members:

E. R. HARRISON, (Chairman) welding department foreman, General Petroleum Corp., Production Division, Taft, Calif.

H. C. PAINTER, welding supervisor, Macco Construction Co., Taft, Calif.

F. A. VARNER, Maintenance Dept. Foreman, Production Division, Murvale Oil Co., Taft, Calif.

E. E. MOSHER, engineer, production division, General Petroleum Corp., Taft, Calif.

G. L. GAMMON, welder, Standard Oil Co. of Calif., Bakersfield, Calif.

L. E. SMITH, welder, Standard Oil Co. of Calif., Bakersfield, Calif.

Personals

WALTER E. HADLEY who has been general superintendent of the corporation's Gary works since February, 1935, was named as manager of operations, Chicago district, succeeding WALTHER MATHESIUS who, on January 1, became vice president in charge of operations, United States Steel Corp. of Delaware. Mr. Hadley will be succeeded at Gary by E. E. MOORE who has been general superintendent of Carnegie-Illinois' South Works in South Chicago since October, 1935. B. M. LIVEZEY will succeed Mr. Moore as general superintendent of South works.

MR. HADLEY began his connection with United States Steel Corp. subsidiaries at the National Tube Co's. McKeesport, Pa., plant and was transferred in 1909 to the Ensley, Ala., works of the Tennessee Coal, Iron and Railroad Co. as assistant superintendent of blast furnaces. After two years as president of the Trojan Electric Steel Co. of Chicago, he was appointed assistant general superintendent of Gary Works in 1918 and general superintendent in 1935.

WALTER E. HADLEY

MR. MOORE has been with United States Steel Corp. subsidiaries since 1919 after he returned from overseas service in the World War. He started in the Gary Sheet mill of the American Sheet and Tin Plate Co., now a part of Carnegie-Illinois. In 1923 he was transferred to the Company's Pittsburgh district, returning to Gary in 1927. In 1932 he was made assistant to general superintendent of South works of the then Illinois Steel Co. and in 1933 was promoted to the position of assistant to vice president. Mr. Moore was made general superintendent of South works in 1935, when the Carnegie and Illinois companies were merged.

MR. LIVEZEY has been with United States Steel Corp. subsidiaries since 1916. He served in various capacities in the Pittsburgh district and in 1926 was made superintendent of the Carnegie by-product coke plant at Clairton, Pa. He was made assistant general superintendent of the Carnegie-Illinois Clairton plant in 1936 and was transferred to the Chicago district in February, 1937, as assistant to manager of operations, Chicago district.

SHARPSVILLE BOILER WORKS Co., Sharpsville, Pa., announces several changes in its sales and engineering personnel. RALPH JOHNS has been appointed manager of sales. DONALD A. JARMAN has been appointed welding engineer for the Alloy and Plate Fabricating Division. Mr. Jarman was formerly research welding engineer for Dow Chemical Co., where he spent several years designing and fabricating special chemical apparatus. The following men have been appointed district sales managers: RALPH J. BENS, New York, N. Y.; ROBERT JOHNS, Detroit, Mich.; EMERSON MULFORD, Akron, Ohio; JOHN J. GREEN, Hollidaysburg, Pa.; L. L. GUTHRIE, Pittsburgh.

DR. CHAUNCEY GUY SUITS, research physicist of the General Electric Research Laboratory, has been selected as America's outstanding young electrical engineer for 1937, according to an announcement by Eta Kappa Nu, honorary electrical engineering fraternity. Dr. Suits' selection was made from a group of 60 candidates less than 35 years of age, submitted by leading industrialists and educators.

Presentation of the award was made during the program of the mid-winter convention of the American Institute of Electrical Engineers, in New York City, January 28th.

BASIL OSMIN, formerly welding consultant for the Elliott Co., Pittsburgh, Pa., has joined the Maryland Casualty Co., Baltimore, Md., as head of the Welding Section of the Engineering Division. He will be stationed at the home office in Baltimore.

BASIL OSMIN

Mr. Osmin is a graduate of the Orenburg Military College and received his early training in welding at the Lincoln Electric Co., Cleveland, Ohio. He has done considerable research work in the metallurgy of weld metal at Washington University, St. Louis, Mo., and also at the Missouri School of Mines and Metallurgy, where he studied under Professor C. Y. Clayton.

Mr. Osmin has just returned from a two-months' trip to Germany where he was assisted by the Verein Deutscher Ingenieure in obtaining first-hand knowledge of modern welding methods in that country and particularly the function of the regulatory bodies which set up codes governing construction of pressure vessels and determine the methods of inspection.

CHARLES R. MOFFATT has been appointed director of advertising of The United States Steel Corporation (of Delaware), 436 Seventh Ave., Pittsburgh, Pa. Mr. Moffatt is under C. V. MCKAIG, newly appointed vice-president. Prior to his new appointment, Mr. Moffatt had been the advertising manager of Carnegie-Illinois Steel Corp. since the organization of that company October 1, 1935. He had been director of exhibits of United States Steel Corp. since July 1, 1935. Mr. Moffatt moves into his new position after 31 years of service with subsidiary companies, beginning in 1907 in the accounting department of the Illinois Steel Co. at Chicago. He assumed charge of sales statistics and advertising of that company in 1919, aand remained in that position until his 1935 appointments.

G. REED SCHREINER has been appointed advertising manager of Carnegie-Illinois Steel Corp. He has been assistant advertising manager of the same company since October 1, 1935. Mr. Schreiner succeeds CHARLES R. MOFFATT, recently appointed director of advertising of United States Steel Corp. of Delaware. Mr. Schreiner was born in Pittsburgh, June 16, 1895, and received his A. B. degree at the University of Pittsburgh in 1916. Following World War service with the United States Army, he entered the advertising department of the former Carnegie Steel Co. in January, 1919,

For EVERY Bronze Welding Requirement There is a TITAN* Rod

Penn Bronze—is a general purpose rod. It is low melting (1620° F.) and tins easily and uniformly on galvanized, cast, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

Double Deoxidation—an exclusive feature found only in Titan Welding Alloys—provides protection against the formation of gases and oxides in bronze welding. Thus you are assured of welds that possess *definitely greater strength and ductility.*

*U. S. Patent No. 2,022,439

If you haven't tried these Titan Welding Alloys, you are invited to send for samples. Test them, and prove the difference to your own satisfaction. Descriptive literature on request.

Titan Metal Manufacturing Co.
Bellefonte, Pennsylvania

and has served continuously with that department.

WALTER H. BRUCKNER has been appointed research associate in metallurgical engineering in the Engineering Experiment Station of the University of Illinois. A graduate of Columbia University and an experienced research worker, Mr. Bruckner comes to Illinois from the United States Naval Research Laboratory in Washington, D. C., where he has been engaged in metallurgical research, principally on the weldability of iron alloys.

Previous to his appointment to the Naval Research Laboratory he served as electro-metallurgist for the Research Corp., research metallurgist with the Crucible Steel Co., and physical metallurgist with the American Smelting and Refining Co. He has also served on the abstract staffs of Metals and Alloys, Journal of the American Ceramic Society, and Chemical Abstracts.

MOXIE S. GEORGE, assistant district sales manager of the Inland Steel Company's Milwaukee office, has been appointed assistant manager of sales for the company's Flat Rolled Steel Division, Chicago, effective April 1.

Mr. George has been associated with Inland's Milwaukee office for several years. Formerly he was affiliated with the Moise Steel Co. of Milwaukee, and with the American Rolling Mill Co., Middletown, Ohio.

CLECO

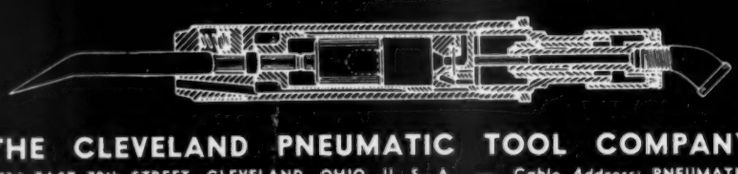
B1 SCALING TOOL

A Scaling Tool That's Different!

Different—and better—is this CLECO B1 Pneumatic Scaling Hammer. One outstanding special feature is the graduated control valve at the rear end of the tool—the harder you press, the more power you get! A special tool retainer holds the chisel securely yet releases it at a touch of the thumb. A square broached chuck keeps chisel from twisting. Exhaust blows away chips and scale.

CLECO B1 is ideal for general scaling, peining and beading; for undercutting when overlapping is necessary; for removing splatter after production welding.

Demonstrations arranged anywhere.
Let us mail you Bulletin 84.



THE CLEVELAND PNEUMATIC TOOL COMPANY

3734 EAST 78th STREET, CLEVELAND, OHIO, U. S. A. — *Cable Address:* PNEUMATIC

BRANCHES IN PRINCIPAL CITIES

Trade Literature

THE OKONITE CO., manufacturer of insulated wires and cables, of Passaic, N. J., has published a new book, "Okonite Insulation." It describes not only how Okonite rubber insulation is made, but also gives tables on resistance, thicknesses, diameters and installation data pertinent to rubber-insulated cables for service up to 5,000 volts.

SPLIT-SECOND WELDING CONTROL BULLETIN—Ways of increasing profits with improved welding quality are suggested in a new Westinghouse 12-page pamphlet, entitled, "New Profits from Resistance Welding with Ignitron Split-Second Control." Ignitron controls are available for spot, seam, butt and projection welding operations, and for applications requiring a single welder for both spot or seam welding. Suggestions for handling unusual welding jobs needing frequent heat adjustment, or different current and time values are discussed in this booklet.

Illustrations include actual installations of ignitron controls for fabricating large and small parts; also, typical parts and products of steel, stainless steel, aluminum and other metals and alloys welded on a production basis are shown. Copies may be secured from the nearest district office of Westinghouse Electric & Mfg. Co. or from headquarters at East Pittsburgh, Pa.

"EYE HAZARDS IN INDUSTRIAL OCCUPATIONS" by Louis Resnick and Lewis H. Carris, of the National Society for the Prevention of Blindness is now offered at the price of 50 cents each as long as the supply lasts. This book sold formerly at $1.50. Although some of the photographs show safety devices which have since been improved upon, the contents remain a valuable guide to safe practices in industry.

"Eye Hazards in Industrial Occupations" is a handbook for safety engineers, safety inspectors; for those responsible for industrial operations, whether owners, managers, or members of the operating staff. Inquiries concerning this volume should be addressed to the National Society for the Prevention of Blindness, 50 West 50th St., New York City.

Welding Instruction Booklet Issued by Steel Corp.

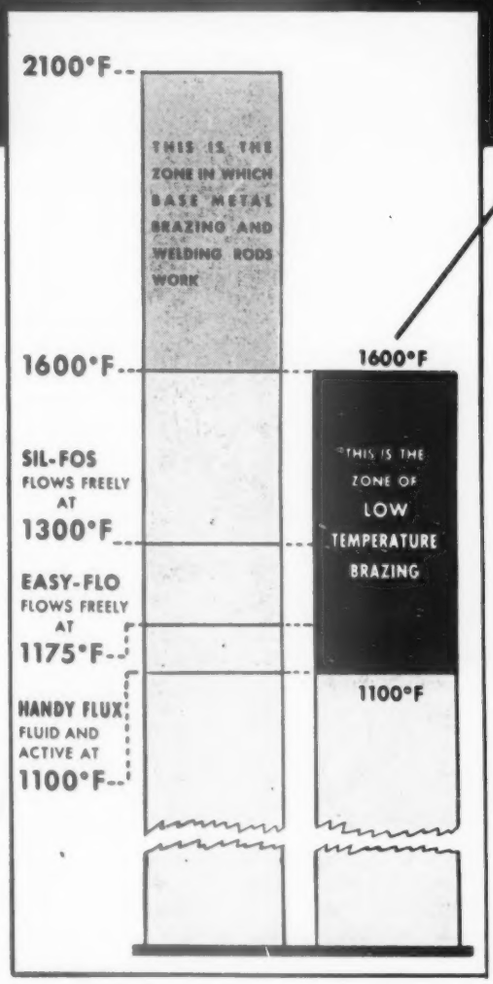
Primarily concerned with methods of showing welding on drawings by the American Welding Society's new symbol system, an attractively bound 81-page booklet entitled "Welding Instructions and Standards—Part I" has just been published by the United States Steel Corp. subsidiaries. This booklet is the first of a series dealing with all phases of welding, and others will soon be issued.

Among the subjects discussed in the new booklet are the symbols for fusion and resistance welding, specifications for individual welds, and a list of various types of welded joints. A useful feature of the booklet is a supplement wherein standard sections of welds, filler metal properties, workmanship and other subjects not directly connected with the section on welding symbols, are briefly treated so that Part I may be of the greatest service to those interested in welding.

Numerous illustrations showing welding technique and various welded products add to the value of the booklet. A typical form for welding drawings is also included, and an example is provided to show how much time and space are saved by the use of the new symbol system as against written instructions. Copies of this new publication may be obtained by writing to the United States Steel Corp. Subsidiaries, Box 176, 434 Fifth Ave., Pittsburgh, Pa., or by applying to any district office of the Carnegie-Illinois Steel Corp.

Welding Alloys Mfg. Co., 110 Washington St., New York City, has issued a small pocket-size folder describing its "W-AL-CO" products for welding of aluminum. The booklet contains technical data in simple form on oxy-acetylene and arc welding of aluminum. Another small folder issued by this company describes the "W-AL-

It pays TO BRAZE IN THE LOW TEMPERATURE ZONE


2100°F
THIS IS THE ZONE IN WHICH BASE METAL BRAZING AND WELDING RODS WORK
1600°F
1600°F
SIL-FOS FLOWS FREELY AT 1300°F
THIS IS THE ZONE OF LOW TEMPERATURE BRAZING
EASY-FLO FLOWS FREELY AT 1175°F
1100°F
HANDY FLUX FLUID AND ACTIVE AT 1100°F

It's costly and in many cases difficult to heat metals and hold the temperatures required by high temperature brazing or welding rods. This is particularly true in joining large plates, heavy sections and metals high in heat conductivity.

LOW TEMPERATURE BRAZING AVOIDS THIS DIFFICULTY. It reduces gas and labor costs and also protects metal physical properties which higher heats sometimes seriously affect.

You get strong, leak-tight, corrosion-resisting joints between ferrous, non-ferrous or dissimilar metals with the low temperature alloys SIL-FOS and EASY-FLO. The joints they make are as strong as the parent metal.

For these reasons—*sound joints* and *economy*—SIL-FOS and EASY-FLO are being adopted by more and more manufacturers. Try them on your work—write for full details today.

HANDY AND HARMAN · 82 Fulton St., New York

Classified Section

ADVERTISING RATES

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

HELP WANTED

SALES AND SERVICE ENGINEERS—Several vacancies in excellent territories for qualified men in Welding and Cutting and Paint Spray Equipment. All or part time. Send in confidence fullest information. Alex. Milburn Co., 1420 W. Balt. St., Baltimore, Md.

FOR SALE

FOR SALE—Well known filler used on cylinder blocks, etc., to stop leaks in electric welds, $1.00 per box of six sticks. Selling limited quantity of shop-worn boxes at $1.00 per box, or two for $1.50. Less than 1/3 regular price. Weldit Inc., 516-1st St., N. W., Washington, D. C.

BARGAINS—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-281, Troy, Ohio.

FLY BALL GOVERNORS—Adapted to all makes of auto engines; belt-driven flat or V. Price, $6.50, prepaid. Ball bearing, $2.00 additional. Satisfaction guaranteed. In ordering state style of belt. Wm. Alber, Beatrice, Nebr.

MISCELLANEOUS

WANTED TO BUY—Used metal spray gun—Please state type and mechanical condition of gun. Must be low priced. Address F-6, The Welding Engineer.

CHARLES KENDRICK, 3550 Graceland Ave., communicate with THE WELDING ENGINEER and advise the city and state you are located in.

POSITION WANTED

WELDER—Age 21, single, 2½ yrs. exp., A-1 on sheet metal, good brazer and electric arc welder. Geo. Holmes, 7429 Vernon Ave., Chicago, Ill.

COMBINATION WELDER—Sheet metal and light steel, also brazing, 1½ yrs. exp. Age 28. Single. Will travel. J. A. Melichar, 5617 S. Richmond St., Chicago, Ill.

ARC WELDER—Experienced. Boiler shop or tank, pipe, construction work, in any position, overhead or vertical. Prefer steady work. Wesley D. Hudson, 3635-A No. 26th St., Milwaukee, Wis.

SHOP OR OFFICE EXECUTIVE—Production, control, design, estimating, and costs in steel fabricating or manufacturing. Wide experience in arc welding, piece work and bonus systems. Address F-4, The Welding Engineer.

ARC AND GAS WELDER—Age 25. Married. Specialized in arc welding. 4 yrs. exp. job shop. Welding school graduate, engineering student. Willing go anywhere. Address F-3, The Welding Engineer.

GAS AND ARC WELDER—Also good machinist—Own tools. Age 32, married, 15 yrs. exp. Can do some drafting, read blue prints. Best references. Any location. Ralph E. Drinning, 4474 Margaretta Ave., St. Louis, Mo.

COMBINATION WELDER—Graduate of Michigan Trade School. Limited experience. Passed tests, vertical and overhead. Will go anywhere. Melvin H. Willems, 93 Parsons St., Detroit, Mich.

MACHINIST AND COMBINATION WELDER—Age 29, steady and dependable. 11 yrs. exp. maintenance and production work. A-1 recommendations. Will go anywhere. R. L. Anderson, Box 412, Washington, Ill.

COMBINATION WELDER—12 yrs. exp. maintenance, construction and production. Hartford certified acetylene pipe welder, Airco back-hand method. Age 32, married. Now employed. Will travel. Address F-2, The Welding Engineer.

WELDER—More than 6 yrs. exp. job shop. Can handle arc and acetylene welding. Frank C. Holtz, 3357 W. Adams St., Chicago, Ill.

WELDER—Trade school graduate. Limited experience. Can do arc welding and gas cutting. Willing to go anywhere in U. S. Raymond Rynes, Gregory St. Briar Hill, Madison, Wis.

ELECTRIC AND GAS WELDER—Age 26, single. Graduate of Universal Welding School. Will work anywhere. H. E. Haessig, Route 3, Madison, Wis.

COMBINATION WELDER—Age 33, 7 yrs. exp., job shop, factory maintenance welding and construction welding on all metals. Also production welding both arc and gas. Graduate elec. engr. Prefer factory maintenance. Karl W. Knox, 6 Sharidan Ave., Mansfield, Ohio.

ARC AND ACETYLENE WELDER—Experienced. Trained in railroad shops and trade school. Experienced factory, piece work, job shop. At present in highway shop. Age 29, married. Want steady position. Address F-1, The Welding Engineer.

COMBINATION WELDER—3½ yrs. exp. job shop, factory and dredge work. Have passed G. E. welding test. Willing give demonstration. Will work anywhere. Address F-5, The Welding Engineer.

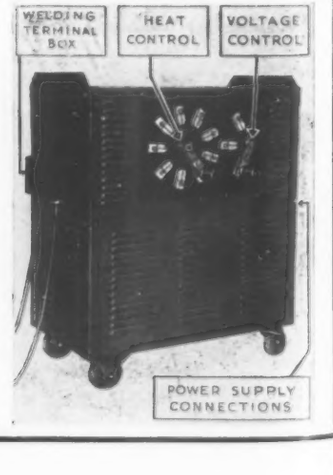
OWEN A-C INDUCTION OSCILLATOR

THE UNIVERSAL WELDER

Ask for Information

OWEN ELECTRIC SALES COMPANY

Fayetteville **North Carolina**



Ryerson a dependable source for Welding Rod

● Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types, including both electric and gas rods, are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment... *Write for Bulletin which gives complete data.*

Ryerson
Shielded Arc Type
No. 215
Shielded Arc Type
No. 216
Shielded Arc Type
No. 217
Green Processed No. 18

Copper Coated No. 206
Copper Coated No. 210
Cast Iron

ELECTRODES

Ryerson
Green Processed No. 6
Bare Mild Steel
Brown Processed
White Flux Coated
High Carbon White Flux
Coated
Blue Flux Coated

GAS RODS

3½% Nickel Steel
High Carbon Bare
No. 2110

Ryerson
3½% Nickel Steel Flux
Coated
High Manganese Steel
Hard Surfacing
Allegheny Stainless Flux
Coated
Allegheny Stainless No. 44

Tobin Bronze
Allegheny Stainless Bare
Hard Filler

JOSEPH T. RYERSON & SON, Inc., Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City

CO" spatter-resisting cover lens for welders' helmets.

McKay Shielded Arc Welding Electrodes is the subject of a small folder issued by The McKay Company, 1005 Liberty Ave., Pittsburgh, Pa., describing the various types of McKay electrodes now being manufactured in the new plant recently completed at York, Pa.

Speer Carbon Co., St. Marys, Pa., has issued a bulletin "Speer Welding Carbon Products" for distribution to users of carbon products in welding shops.

Progressive Hydraulic Punching and Stripping Machines is the title of Bulletin No. 3803 just issued by the Progressive Welder Co., 737 Piquette Ave., Detroit, Mich. With the help of simple sketches, the booklet makes clear the variety of production applications of the multiple-unit idea in the field of hydraulic punching and stripping.

General Motors Corp., Broadway and 57th St., New York City, has issued a booklet "An Automotive Contribution to Railroad Progress," which carries a report of a luncheon meeting held in New York City a few months ago, the purpose of which was to survey the progress of diesel motive power on the railroads. The meeting also marked the 40th anniversary of the first successful oil-burning diesel engine. Copies of addresses by Charles F. Kettering, vice-president of General Motors Corp., in charge of research; H. L. Hamilton, president, Electro-Motive Corp., and Ralph Budd, president of Burlington Lines, are reproduced in the new booklet.

Rubber-Insulated Cables is the title of a sound motion picture film just released by The Okonite Co., 501 Fifth Ave., New York City. This movie illustrates all the steps in the manufacture of rubber-insulated wires and cables, from the gathering of raw materials to the use of the finished product. The time of showing the film is approximately 25 min.

General Electric Co., Schenectady, N. Y., has issued a well illustrated bulletin describing the full line of arc welding accessories which G-E manufactures or distributes. Among the products covered in the booklet are helmets and hand shields, electrode holders, protective clothing, gauges, brushes, and cable connectors.

"Portable Hydraulic Welding Guns and Equipment" is the title of Bulletin 3802 just issued by Progressive Welder Co., 737 Piquette Ave., Detroit, Mich. Numerous sketches are shown of the various types of hydraulically-operated spot welding guns for application in the automotive industry.

Industrial Compressors and Vacuum Pumps is the title of a new bulletin recently issued by Ingersoll-Rand Co. The units described range in size from ¼ to 15 hp. Rating tables are included for more than 50 models in the "Type 30" line. Physical dimensions, capacities, pressures and horsepower ratings are included. Copies are available by writing to Ingersoll-Rand Co., 11 Broadway, New York, N. Y., or any branch office.

Economical

Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter.

An unusually large file area is provided—approximately one square inch. The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position, permitting instant replacement. The lighters are cadmium plated, rustproof.

Descriptive circulars and prices on request

ORIGINATORS OF THE HAND GAS LIGHTERS **SAFETY GAS LIGHTER CO.** Est. 1901 **LYNN, MASS.**

Help!

Help!

WHO OF US DOES NOT NEED HELP on many problems in Welding. Only a few of us are entirely self-sufficient—or rather feel that we are—the association with welding leaders which the American Welding Society provides and the cooperativeness which it encourages and inspires are invaluable. Welding leaders everywhere personally say they could never repay what they have learned; a good bit of advice on a delicate problem, a side light that was very illuminating on some process or qualification control or a frank and friendly bit of criticism from those whom they have met at local Section meetings or at national Conventions or from the ideas they have gained in articles appearing in the Welding Journal each month.

Membership in the AMERICAN WELDING SOCIETY is a good investment.

Information address

American Welding Society
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or
The Welding Engineer
608 South Dearborn Street
Chicago, Illinois

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